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Activation of Sludge By Mechanical Aeration

Development of Mechanical Aeration, Application to Activated Sludge Plant, Described

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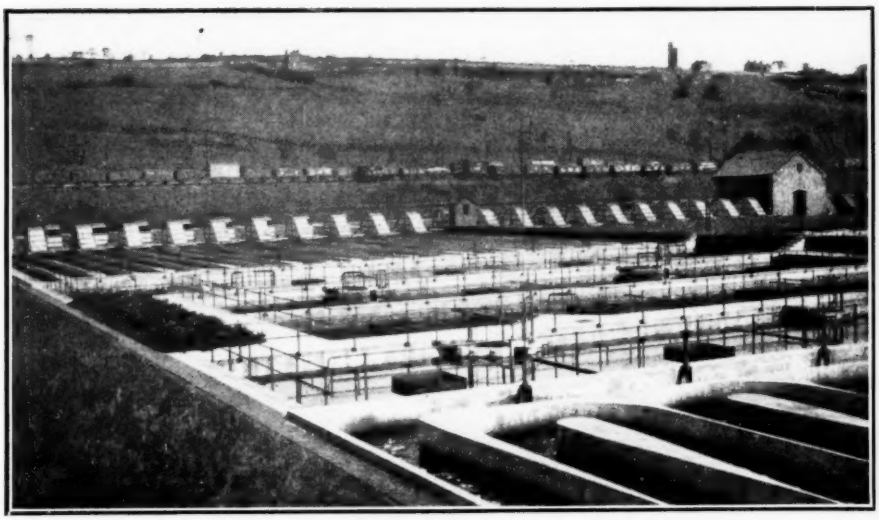
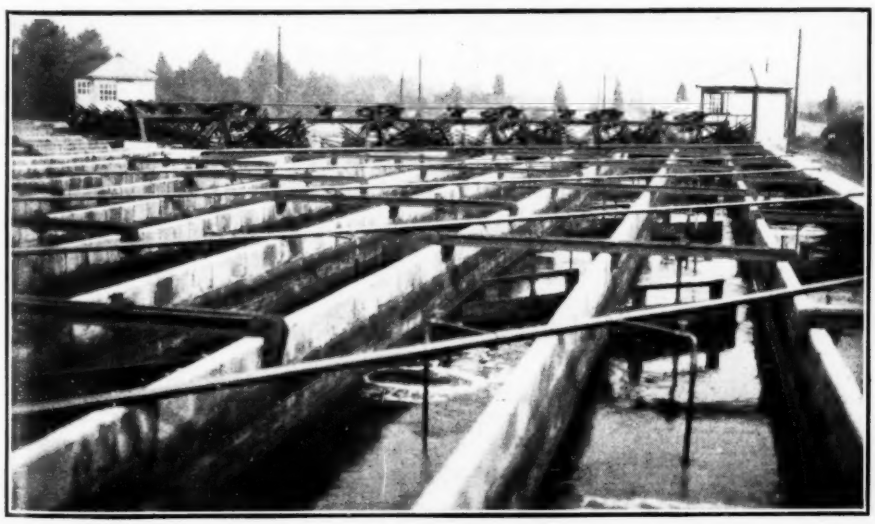
THOROUGH aeration and agitation of sewage under treatment are fundamental requirements of the activated sludge process. With the exception of certain plants in England and a limited few in this country, compressed air always has been used to accomplish the purpose. However, there is now a growing tendency among engineers and others to consider the use of purely mechanical devices as distinguished from compressed air to produce the aeration and agitation required. It is the purpose of this paper, therefore, to discuss certain types of mechanical agitators which eventually may become of more or less common use.

However, to understand how mechanical agitation operates to produce the desired results, some knowledge of the activated sludge process is first necessary. A brief description of the underlying principles of this process will therefore be given.



General View of Present Sheffield, England, Plant. Haworth Paddles are Used

Activated Sludge Process.—The activated sludge process has been defined by the Sewerage and Sewage Disposal Committee of the Sanitary Section of the American Public Health Association as one which "consists in the agitation of a mixture of sewage with about 15 per cent or more of its volume of bacterially active liquid sludge in the presence of ample atmospheric oxygen; the agitation to continue for a sufficient period of time to at least accumulate a large proportion of the colloidal substances, followed by sedimentation adequate for the subsidence of the sludge flocculi; the activated sludge having been previously produced by aeration of successive portions of sewage and maintained in its active condition by adequate aeration by itself or in contact with sewage."



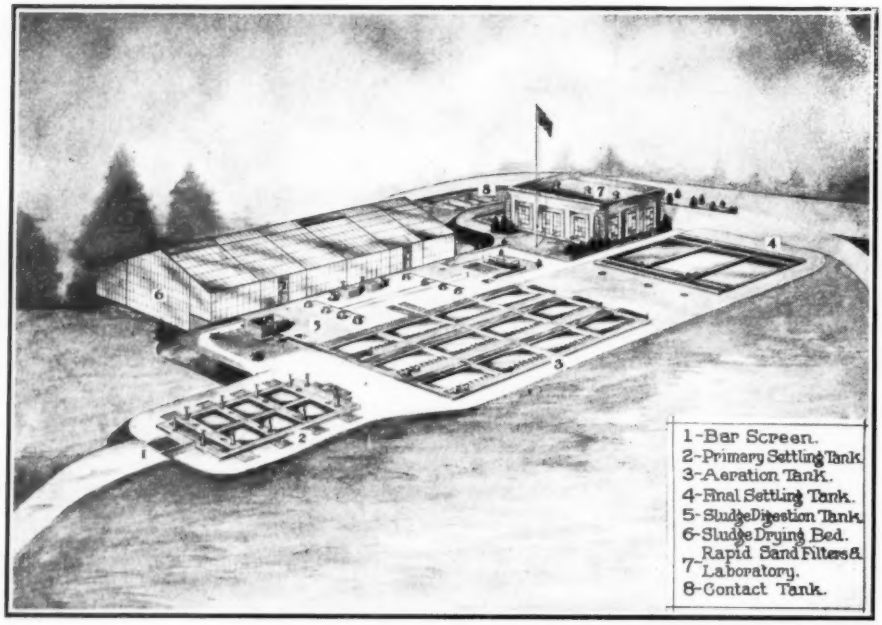
Birmingham, England, Plant, with Hartley Paddles

This definition, translated into terms of at least one type of working plant of moderate size and recent design, implies that ways and means must be provided for: first, elimination of grit, if any is present; second, separation of the coarse solids from the incoming sewage; third, aeration and agitation of the partly clarified sewage in the presence of sludge which has been previously activated; fourth, sedimentation of the aerated sewage; and fifth, disposal by digestion or otherwise of the coarse solids which were first taken from the incoming sewage, together with the surplus of activated sludge not needed for mixing with the sewage while it is being agitated and aerated.

In the operation of a plant of the type just outlined the raw sewage is first passed either through a fine screen or a pre-sedimentation tank, for the purpose of removing as much of the coarser solids as possible. It then enters the aeration tank, where it is mixed with from 10 to 25 per cent by volume of previously activated sludge and then agitated for a period of approximately 6 hours. The resultant mixture of sewage and sludge is then conducted to the final settling tank, where the floc which has been formed is removed by sedimentation and the clear liquid passed from the plant if the degree of

purification so far provided has been sufficient.

A part of the floc or activated sludge deposited in the final settling tank is returned to the aeration tank, where it is again brought into contact with the sewage which is being aerated. In continuous flow plants the cycle of mixing of activated sludge with fresh sewage, aerating and agitating the mixture, settling out the floc and returning a portion of it to the aeration tank is repeated over and over again.



Perspective Drawing of the Activated Sludge Plant Described in the Text. Capacity 600,000 Gal. Per Day; Designed for a Population of 6,000

The process which has thus been briefly outlined is one which is biochemical in nature. It is also similar to that which takes place in a plant where sprinkling filters are used. In the latter the sewage is brought into close contact with growths of oxidizing bacteria which form the bacterial slime on the surface filter media. In the activated sludge process, particles of sludge of similar composition are circulated through the sewage under treatment. Agitation is used to circulate and mix the fresh sewage with the activated sludge. Air is also required to furnish the atmospheric oxygen necessary to promote the growth of the oxidating bacteria. It will be seen, therefore, that both aeration and agitation are fundamentally necessary as a part of the process.

Use of Compressed Air.—In the past, compressed air has been most frequently used for the purpose, since when properly introduced into the liquid it will both agitate it and at the same time supply the oxygen required for aeration. Air is usually introduced into the tank through porous plates in the bottom. In some plants the plates are evenly distributed throughout the area to be aerated. In others the plates are arranged in rows at equal intervals crosswise of the tank so as to form air baffles consisting of curtains of ascending bubbles, through which the sewage must pass. Of late, there has been an increasing tendency to introduce the compressed air through plates located in rows at one side of the bottom of the tank. When this is done in rectangular tanks with proper longitudinal baffling the force exerted by the ascending air along only one side of the tank imparts a rotary motion to the sewage. This results in the sewage traveling in a spiral path from one end of the tank to the other, and the maintenance of a velocity sufficient to prevent settlement of sludge.

Like every other process, the use of compressed air is attended by certain disadvantages. Only a small portion, or about 7 per cent, of the air which is blown through sewage is used for oxidization. The remainder, or 93 per cent, serves only to produce agitation. To use air for this purpose is expensive, in view of low efficiency, relatively high cost of plant distribution system and the losses due to friction in the pipes and diffusers. In addition, the greatest care must be taken to prevent the clogging of the fine pores of the diffuser plates with atmospheric dust, oil from the compressors or rust from the air pipes. It likewise might be added that it cannot be considered desirable to have the essential parts of a plant always submerged in liquid and not easily accessible or usable when in operation.

Experiments in Mechanical Aeration.—In 1905, Adeney of England performed certain experiments which proved that while the surface of de-aerated water remained smooth, absorption of oxygen from the air was extremely slow, but that when the surface was kept gently broken the water was rapidly aerated. Later experiments made in 1921 by Haworth and Hodgkinson, two English engineers, led them to conclude that the surface of air bubbles was not especially suited to permit solution of oxygen from the bubble itself, and that the great change of surface produced at the top of the liquid by rising bubbles probably accounted for the large amount of the solution of oxygen obtained. This was evidently proven to their satisfaction, for they substituted bubbles of nitrogen gas for air and found that the absorption of oxygen into solution still took place. These experiments, with others of a biological nature, indicated that sewage could be successfully aerated by mechanical means as distinct from the use of compressed air.

The first large-scale plant employing mechanical agitation was placed in operation at Sheffield in 1920. The aeration tank had a capacity of about 355,000 British gallons daily. In size it was approximately 201 ft. long by 75 ft. wide, with a depth of 4 ft. It was subdivided into 18 chambers, each 4 ft. wide and with alternate ends connected so that the sewage traveled back and forth a distance of approximately three-quarters of a mile from inlet to outlet ends. Skeleton paddle wheels, one to each channel, on shafts extending across the tank at its center, were used to agitate and propel the sewage. By the action of the paddle wheels the sewage was caused to circulate continuously back and forth from one channel to another at a velocity of about 1.7 ft. per second. Thus the liquid was agitated and rapid surface changes were created. The purification obtained was considered generally satisfactory, as a well oxidized and non-putrescible effluent was produced.

Keeping Sludge in Suspension.—The reactions which occur in a tank of this type have been compared with those which take place in a flowing river, wherein sewage is received and purified by the natural processes at work. However, aeration of sewage in channels like that in a river has its difficulties. Activated sludge sinks at approximately the rate of one inch per minute. Thus, at a velocity of 1½ ft. per second, sewage will have traversed 90 ft. before the sludge has settled an inch. Therefore, linear velocity alone aids very little in keeping sludge in suspension.

In order to overcome the tendency of sludge to settle and at the same time to expose a greater surface for aeration, a spiral flow has been imparted to the liquid. This, as already explained, has been obtained in the case of tanks using compressed air by placing the diffusers to one side. In certain English plants, where the aeration tanks consist of long channels, there is in use what is termed a high-efficiency inclined paddle. One of these paddles is located at the U-bend or return end

of each channel. In action, it propels the sewage with high mechanical and hydraulic efficiency around the bend and along the channel. At intervals along each channel are placed straight, flat plates. They are virtually immersed in the liquid at an angle inclined to the flow. They produce a perfect rotary flow and permit a reduction of the linear velocity from 1.5 ft. per second to 0.5 ft. per second without tendency to settlement on the part of the sludge. It is reported that the process using this device and known as the Hartley spiral flow process, has been found to give results very nearly equal to that obtained with compressed air with the same period of contact and at only half the power.

There are now two types of mechanical aerators which are being introduced to American practice. One is known as the Simplex surface aerator and the other is the Link-Belt aerator.

Simplex Surface Aerator.—In his early experiments, Haworth used a vertical cylinder equipped with a propeller which could be rotated rapidly to induce circulation. The flow through the cylinder was downward, with the return flow taking place in the tank outside. Mr. Bolton, manager of the sewage works at Bury, and the Ames Crosta Engineering Co. developed a similar machine, but with an upward circulation. This machine is now known as the Simplex surface aerator. It consists of a stationary cylinder or uptake tube, 2 ft. 6 in. in diameter, with the exception of the bottom, where it is enlarged in the form of a cone. At the surface is a revolving disc, 5 ft. in diameter, fitted with vanes, designed to throw a thin upper and lower sheet of liquid across the surface of the tank. As the sewage which is being sprayed strikes the surface of the liquid in the tank, numerous air bubbles are formed. In addition, there is set up a downward circular motion of the sewage, which mixes the activated sludge with the incoming raw sewage. All liquid thrown out by the revolving cone comes through the uptake tube from the bottom of the tank, assuring positive circulation. The machine is usually installed in tanks 22 ft. square by about 15 ft. deep. Power consumption approximates 14 kwh. per million gallons of sewage treated.

There are a number of installations of Simplex aerators that are in operation and giving excellent results. So far it is the only mechanical aerator that has been adopted for use in this country.

Link-Belt Aerator.—The Link-Belt Co. of Philadelphia has recently developed a new type of aerator which offers much of promise. It produces the spiral form of circulation similar to that already described. It differs in practically no way from the "spiral flow process" as developed by Hurd at Indianapolis, with the exception that purely mechanical means are used instead of diffused air.

Agitation and circulation are produced by the action of a revolving, paddle-like element of small diameter, located at one side and extending the whole length of a tank. The blades of the paddle are in the form of a comparatively narrow, broken ribbon, pitched both ways. The center of the shaft that carries the paddle blades is located a few inches above the surface of the liquid at a distance of approximately 3 ft. from the side of the tank. The outside diameter of the cylindrical surface formed by the paddle blades when they revolve is about 26 in.

A vertical baffle wall is used to prevent short circuiting of liquid in circulation. This wall is placed parallel to and at a distance of 18 in. from the wall of the tank. It extends from a point a few inches above the surface of the water to within 18 in. of the bottom of the tank. A metal apron, curved to conform with the path of the paddles, extends from the baffle wall, underneath the rotating mechanism about two-thirds of the way to the surface of the water. Upon starting up the paddles the sewage is drawn over a weir located at the top of the baffle wall and forced across the tank on the surface at a velocity of approximately 2.5 ft. per second. Upon reaching the opposite side of the tank it meets a deflector, which directs it downward. It then sweeps across the bottom of the tank and rises up behind the baffle wall to meet the paddles again. It is in this manner that a spiral flow is created, which begins the moment the sewage enters the tank and does not cease until it leaves it. Thorough agitation and surface aeration are therefore accomplished.

The bottom velocity has been found by test to be a minimum of approximately 1.5 ft. per second, which is sufficient to prevent settlement or the accumulation of solids. Power consumption is estimated at 14 kwh. per million gallons of sewage treated.

Other Adaptations.—So far, the discussion on mechanical aeration has been in conjunction with activated sludge plants only. This discussion would not be complete without bringing up the possibilities of mechanical aeration as applied to existing plants having settling tanks for primary treatment and sprinkling filter beds for secondary treatment.

Link-Belt Mechanical Aerator at Maywood Plant of the Sanitary District of Chicago, in Operation. Capacity 52,400 Gal. Per Day; Detention Period Six Hours

The development of communities has, in numerous instances, been so great that the capacities of their sewage treatment plants have been reached and exceeded in much less than the estimated time. While the problem in these instances is entirely one of finances, the burden falls on the engineer, who must devise ways and means of overcoming the difficulty at the lowest possible cost, since in some instances a plant extension is required before the bonds covering the original plant have been retired.

Pre-aeration of settled sewage prior to its application to the sprinkling filter beds appears to offer at least a partial solution of this problem. By aerating the settled sewage for periods approximating one hour, the reduction in the b.o.d. of the settled sewage approximates 25 to 30 per cent. This reduction in b.o.d. is apparently due to the absorption of oxygen by numerous exposures to the air of the sewage.

Aeration partly accomplishes the biochemical decomposition of organic mat-

A Simplex Unit at Princeton in Operation

ter by the utilization of dissolved oxygen through bacterial activities on an aerobic basis and in effect accomplishes the same results as are obtained in the upper section of a sprinkling filter bed.

The amount of oxygen absorbed by surface aeration is a function of turbulence, area and time. Turbulence is obtained in mechanical aeration by the rapid breaking up and throwing of the sewage across the surface of the tank. Area and time would naturally be determined for each installation and would depend on the character of the settled sewage and the aeration required.

Some idea of the rapid exposure obtained with mechanical aeration can be had by considering a tank, say 15 ft. wide by 60 ft. long, at an average surface velocity of 2½ ft. per second. This would require 6 seconds to make a surface change, which would be equal to 10 per minute or 600 per hour. With a surface area of 15×60 or 900 sq. ft., this is equivalent to 540,000 sq. ft. or approximately 12 acres per hour, or 288 acres per day.

So far, several plants have considered this possibility and experiments conducted have proven that oxygen is absorbed by aeration. Therefore, aeration of the sewage between the settling tanks and the sprinkling filter beds should decrease the b.o.d. of the sewage as applied to the beds and should allow an increased loading on the beds by an amount approximately equal to the reduction obtained by aeration.

Application to Activated Sludge Plant.—It may be of interest to describe a treatment plant of the activated sludge type, using mechanical aeration. This plant is shown in perspective in an accompanying illustration and is now under contract for construction. As the effluent from the plant is discharged into a small brook an extremely high degree of treatment was required by the department of health for approval of the plans. In brief, it is anticipated that the final effluent will have at least a 10-day stability and bacteria absent in 50 cc.

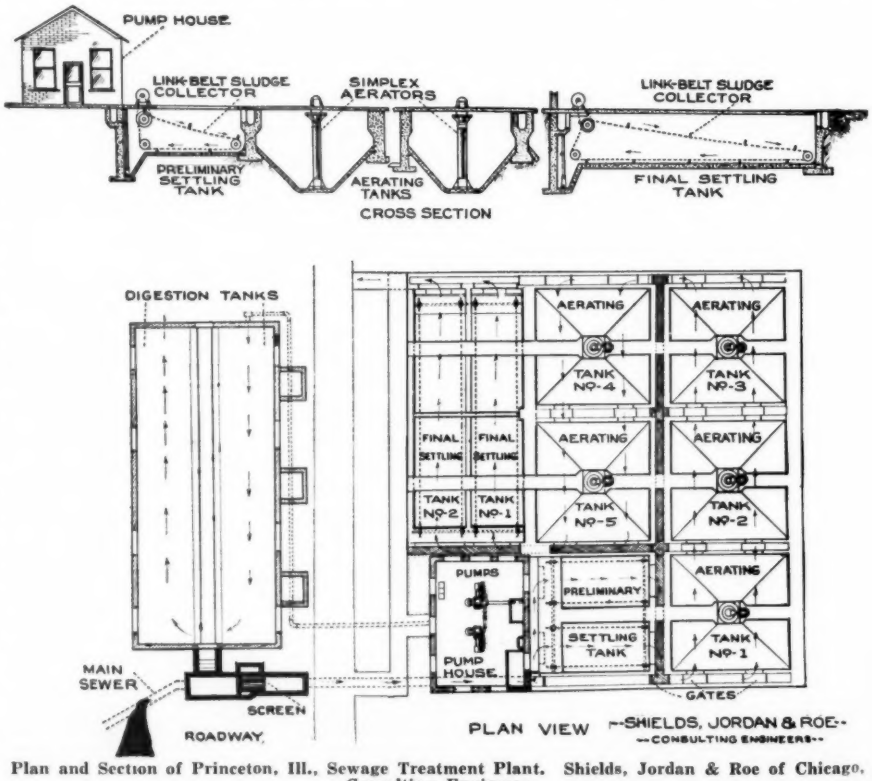
The plant is designed for a capacity of 600,000 gal. per day and a population of 6,000. Units of treatment consist of:

1. Preliminary clarification tank, having a detention period of one hour.
2. Aeration tanks having an aerating period of 6 hours, including 25 per cent return sludge.
3. Final settling tanks having a detention period of 1½ hours with 25 per cent returned sludge.
4. Rapid sand filters, operating at the rate of 1½ gal. per sq. ft. per minute.
5. Contact tank for sterilization, having a detention period of 30 minutes.
6. Sludge digestion tank based on 2.0 cu. ft. per capita with heating coils and gas collection.
7. Glass covered sludge drying beds.

The preliminary clarification tank is preceded by a bar screen and a sand trap. The tank is divided into two separate compartments having hoppered bottoms for the accumulation of settled sludge, the withdrawal of which is effected by sludge piping operating under a hydrostatic head of 4 ft. The effluent from the tank is discharged into a sewage diversion chamber, designed to divert equal volumes of sewage to each of the aeration tanks.

Mechanical Aeration.—The aeration tanks are divided into three separate compartments, each equipped with a Link-Belt aerator. Activated sludge return piping has been arranged so that the point of application can be varied, as it may prove to be decidedly beneficial to aerate the sewage prior to the application of activated sludge. The effluent from each compartment is discharged over weirs and piped to the final settling tanks.

The final settling tank is also divided into three separate compartments, each compartment being equipped with mechanical scrapers for the concentration of the settled sludge. The sludge is collected in hoppers located at the influent end of the tank and is removed through a vertical sludge pipe connected to a sludge channel. The upper part of this pipe has an adjustable section, which contains a V-notch weir over which the sludge is discharged. The



Plan and Section of Princeton, Ill., Sewage Treatment Plant. Shields, Jordan & Roe of Chicago, Consulting Engineers

position of this weir can be adjusted to meet almost any sludge return rate. The effluent from the tank spills over weirs and is piped to the rapid sand filter beds.

Rapid Sand Filters.—There are four rapid sand filters, each having an area of 70 sq. ft., giving a total area of 280 sq. ft. These rapid sand filters are identical with those used in a water works and are equipped with filter sand, graded gravel, manifold system, rate controllers, loss-of-head and rate-of-flow gauges, etc. An automatic closing-off device is provided to function during periods of low flow so as to prevent the level of the sewage from falling below the sand line. Washing of the filter is accomplished by a wash-water pump and the waste wash water is discharged into a reservoir placed under the filter beds, from which it is pumped out at a very slow rate and returned to the influent end of the plant. The filters are housed in a building which will also house the chlorinating apparatus, the air compressor units for sludge lifts, laboratory equipment, etc.

The effluent from the filters is chlorinated and piped to a contact tank, from which it discharges through the outfall sewer to the brook.

Sludge return from the final settling tank is effected by piping the sludge to a sump, in which is placed an air lift to lift the sludge into a sludge diversion chamber, from which it flows over three V-notch weirs, one for each compartment. It is then piped to the aeration tank and surplus sludge piped to the sludge digestion tank. Sludge from the clarification tanks is also piped to a compartment alongside the activated sludge sump and lifted up and discharged to the sludge digestion tank.

Sludge Digestion Tank.—The sludge digestion tank is divided into two separate compartments. Each compartment is divided into channels by baffles, placed so as to obtain a roundabout passage for the sludge. Raw sludge from the clarification tank and excess activated sludge are piped to the influent end of either compartment so that they are mixed as they enter the tank. Arrangements for seeding with digested sludge have been provided and consist of an air lift placed in the sludge discharge pipe, which lifts the sludge into a compartment from which it is piped to the influent end of the digestion tank. Digested sludge is discharged under a hydrostatic head of 4 ft. to a channel connected to each sludge drying bed. Supernatant liquor will be removed by means of a rotary type decanting valve designed so that liquor can be taken off at 6-in. depth intervals throughout the full depth of the tank.

Heating coils have been provided for each compartment, consisting of 1½-in. wrought pipe laid in the bottom of the channels. The entire tank will be practically gas tight and will be provided with gas domes to collect the gas. These are manifolded and piped to a gas-fired hot water boiler placed in a boiler room alongside of the sludge digestion tank. Pressure relief tank, condensation traps and fire traps, have been included with the boiler room equipment, together with gas and water meters, circulating pump, heat regulating apparatus, etc.

Glass Covered Drying Beds.—The sludge drying bed is of the glass covered type and is divided into six compartments. The beds are of the conventional type, consisting of 6 in. of sand supported on 9 in. of graded gravel. Each bed contains an open-joint underdrain piped to a main drain, which in turn discharges into the waste wash-water storage tank under the filter building. Drained liquor is pumped back to the influent end of the treatment plant.

Means have been provided for bypassing excess activated sludge during the summer months direct to the sludge drying beds, provided the direct drying of the sludge can be effected in this manner.

The cost of this plant, having a capacity of 600,000 gal. a day, was only $97,000.

Acknowledgment.—The foregoing paper was presented at the 14th annual meeting of the New Jersey Sewage Works Association, held on March 22 and 23 at Trenton.

Water Softening and Purification at Columbus, O.

During 1928 an average of 29.4 million gal. of water was softened and filtered by the Water Works of Columbus, O. This represents 98 gal. per capita per day. The following details of the work are taken from the report Charles P. Hoover, Chemist in charge:

Hardness of Water.—The hardness of the water was reduced from an average of 242 parts per million to an average of 86 parts per million. A reduction of 64 per cent.

Quantity of Chemicals Used and Their Cost.—To reduce the hardness of the water from an average of 242 parts per million to 86 parts per million, 2,673 tons of soda-ash and 7,991 tons of lime were required. The price paid for soda-ash was $27.74 per ton, and the price paid for lime was $6.52 per ton, making the total cost for soda-ash $74,149.02 and the total cost for lime $52,101.02. The cost of lime, soda-ash, alum and chlorine per one million gallons of water treated amounted to $13.67.

Turbidity and Color Removed.—The average turbidity or muddiness of the river water during the year was 108 parts per million, whereas the turbidity of the filtered water was zero. The average turbidity has been higher during the past three years than in former years. This is due to the O'Shaughnessy dam which holds back the flood water, causing the water coming to the plant to be muddier for longer periods of time. The average color present in the above water derived from decay of vegetation, was 23 parts per million. By the combined use of lime, soda-ash and alum, the color was reduced in the filtered water to one part per million. A color of one part per million is not noticeable to the consumer.

Typhoid Fever.—There were five deaths from typhoid fever during the year 1928, three of which were resident and two non-resident. Figuring the population at 299,000 (state bureau of vital statistics estimate) would give the city a total death rate from typhoid fever of 1.7 per 100,000, a resident death rate of 1.0 per 100,000 and a non-resident death rate of 0.7 per 100,000.

Recarbonation Plant.—The recarbonation plant has been operating successfully during the entire year.

For the past 19 years the alkalinity of the filtered water has averaged 55 P. p. m. During 1928 by the aid of recarbonation, it has been possible to reduce the average alkalinity of the filtered water to 43 P. p. m. For 19 years the average reduction of alkalinity has been 66 per cent as compared to 72 per cent during the past year. The filtered water has during the past 19 years carried caustic alkalinity or excess lime to the extent of 5 P. p. m. whereas, with recarbonation there has been no caustic alkalinity. Normal carbonates, which cause trouble due to formation of deposits on filter sand and in distribution pipes and meters, have been reduced to a figure which is well under its solubility limit.

Trouble with filter sand, through which the entire water supply is filtered, due to the grains cementing themselves together and forming hard lumps has we believe, been entirely eliminated. There has been great improvement in the operation of the condensers at the pumping station. In former years it required three days to clean a condenser. Now the job is easily done in one day. Further growth of deposits in the distribution system seems to have ceased. There has been a reduction in the number of meters clogged by carbonate deposits and the cleaning out of hot water coils has been reduced to a minimum.

Methods of Thawing Frozen Hydrant.—A study made recently by the New York State Bureau of Municipal Information, showed that 25 municipalities used steam for thawing frozen hydrants, 10 used electricity, 7 used a commercial hydrant thawing device and 5 used salt, carbide or other material. Two municipalities used alcohol in the hydrants to prevent freezing.

Factors In Cost of Water Mains

Methods Used in Practice and Design

By JAMES P. IRONS

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IT is my thought that this subject should be treated from the economic viewpoint rather than from the position of detailed costs of the different items involved in the construction of the various classes and types of water mains. With this idea in mind I will give consideration to the various methods used in the practice and design of water mains and their construction.

Too Much Paring Down Costs.—It has been my experience that in the administration of our public works, there has been too much of an effort made to pare down to the very minimum, the first cost of construction of all kinds. This is not done so much by engineers as by public officials in elective offices, who are more or less responsible to the mind of a fickle public, on the various amounts of money expended by them; whether it be for improvements and betterments, or simply for the administration of the various duties their offices may demand.

I have made these statements, not to give you the idea that we should indiscriminately raise the first cost of construction to the point where it is prohibitive; but rather that we should depend upon the recommendations of specialists and that we should also give careful thought to the methods, and their costs, that will have to be used for the maintenance and service of the different types of pipe lines, in years to come.

The Question of Valve Manholes.—Let me offer as an illustration, the question of whether or not to plan for the installation of valve manholes or to use the practice of simply installing a valve box. It seems obvious that it is much more economical in the end to use the manhole installation, even though the first cost is slightly more, for it is much cheaper to simply raise the manhole cover, than to have to remove and replace pavement, and completely uncover the valve every time it needs repairing. I have used the above illustration for the reason that it has been brought before me very forcibly in the last year, inasmuch as we have instituted a continuous system of valve inspection and maintenance and through that we found at least 50 per cent of our valves needed servicing of some kind. The maintenance was made doubly expensive by the fact that very few of the valves had been set in manholes during the original construction.

The Size of Mains.—The question of what size lines to lay in the different parts of the system plays an important part in the cost of water main construction. The thought runs in my mind that to date, we haven't lived long enough to know what to anticipate as the life of a cast iron water pipe under natural conditions. Cast iron water mains, of course, have failed from unnatural conditions such as electrolosis, acid action and other forms of oxidization due to certain local conditions, which in most cases can be remedied. With this fact before us it becomes apparent that we should plan the size of the installation to care for the demands that may be made on it at least 100 years hence. I ask permission to use another illustration. It was very surprising to me to find that in the City of Topeka, where the mains were first laid only 40 years back that one of the streets in the very heart of the business district was serviced with only a 4 in. line. I have reference to distribution lines and not to main feeder lines. From pumping stations; the size of which are automatically controlled either by the volume of water at your disposal at the pumping plant, or by the conditions existing with respect to the relative location of the pumping plant and the distribution system.

Two Main Systems.—To get back to the distribution system; several cities have already gone to the installation of what is known as the two main system, among which are Boston, Chicago, Detroit, New York, Cleveland, St. Louis and several others. This, as is inferred in the name, consists of laying a main on either side of the street behind the curb.

Hydrant Installations. — It would seem that the question of the number and type of hydrant installations should have a prominent place in the planning of distribution systems. I am of the opinion that hydrants should never be set on less than a 6-in. leg and that all the legs should be valved where they leave the main. Careful thought should also be given to the method of setting the hydrant so that adequate drainage will be provided and the drain also protected from the growth of roots, and other natural processes which tend to clog the drain and cause trouble in the operation of the hydrant.

Valves.—The matter of valves now presents itself. As mentioned before I am thoroughly convinced that all valves should be installed in manholes during the original construction. We should give careful consideration to the number and location of valves. It should not be necessary to valve off and kill the service in eight or ten blocks, to repair a broken main in one block, inasmuch as the main was originally laid for service to the consumer, and he has every right to expect an uninterrupted service, and we should prepare to deliver that service.

Establishment of Official Grade.—The planned design of all parts of a distribution, since the lines are generally laid ahead of all real estate development and the paving and sewer projects; must necessarily be dependent on the establishment of an official grade, by the city engineers office and made legal through ordinance by the city commission.

This idea has been in use in several of the larger cities for some time and has, in one way and another, saved them thousands of dollars for the simple reason that it is possible to plan all construction from a given point; and does not necessitate the changing of one plan to conform to another, either before or after the work has been completed. I mention this for the reason that in so many cases we plan and lay our lines then find that after the paving is completed we are without sufficient protection from frost, and thereby are forced to revamp, at a large expense, a part of our completed work.

The various thoughts mentioned in this paper are all vital parts of the cost of water main construction and unless we consider them, as such, we are merely fooling ourselves as to the real costs of our water mains.

Acknowledgment.—The foregoing is an abstract of a paper presented before the Kansas Water Works Association.

Decline in Death Rate at Boston, Mass.—In 1875 the city of Boston published a report of a special medical commission on The Sanitary Condition of Boston, which contains a wealth of suggestive information. At that time the death rate of Boston had varied from a maximum of 31.8 per 1,000 for the year 1872 to a minimum of 22.3 for the year 1867, but giving a mean annual death rate for a ten-year period of about 25 per 1,000. The death rate of Boston for the year 1927 will be about 14 per 1,000, or an annual saving of 11 per 1,000, equivalent, on the estimated population of Boston, to 11.102 deaths.

Earth Current Surveys for New Pipe Lines

Importance of Preliminary Survey of Electrical Conditions

By E. E. MINOR

Chief Engineer, New Haven Water Co., New Haven, Conn.

IN the selection of a route for a new feeder main, geographical and profile studies may not present all of the engineering aspects of the problem which need consideration. Stray currents, which are often overlooked in the location of a new pipe line, may be the governing factor in the eventual life of the pipe. Therefore, they are decidedly worth studying before the pipe line location is definitely decided upon. If hazardous conditions are found on one route, it may be possible to avoid them on another, or as often happens, the stray current hazards can be materially reduced or eliminated before the pipe is laid. An accurate knowledge of all phases of the stray current problem as it affects the new pipe line is also of vital importance in the design and construction of the lien, because mitigative measures can be applied much more easily and cheaply as the line is laid, than they can after the job is once completed.

In developing a water supply for New Haven we have planned a 48-in. pipe line coming into New Haven on the east. This roughly parallels an interurban electric railway for about 5 miles. The soil is for the most part sandy and of relatively high electrical resistivity. Approaching the city we pass under another electric interurban line with the soil changing to low salt water marshes of low resistance, through which our line would pass for about 2,000 ft. and then under a broad tidal estuary, 1,500 ft. in width, to a sandy high resistance soil in the city.

Earth current surveys were made by Albert F. Ganz, Inc., of New York City under the direction of its engineer, C. F. Meyerherm. The results were surprising and we have included the report in this paper, thinking it would be of interest, in a general way, to members of the Association. Here are soil resistances ranging from 420 to 126,000 ohm-centimeters; voltage gradients running from neglible values up to magnitudes of 282 volts per thousand feet. Needless to say, much improvement will be made in these conditions before our pipe is laid. We believe it shows, however, the value of investigating these conditions before installing thousands of dollars in pipe line which would be immediately subject to depreciation from causes which could be partly eliminated and partly guarded against. The report follows:

Report on Electrolysis Survey.—In accordance with our understanding with you we have made a series of electrolysis tests at characteristic points along the route of the proposed North Branford-New Haven water supply main and we give you herewith our report on the results.

The object of the present investigation was to determine: (a) existing stray current gradients in the earth in the territory through which the proposed pipe line will pass; (b) the electrical resistivity of the soil at characteristic points along the route; and (c) the most desirable locations for any electrically insulating joints which might have to be installed in this pipe line in order to minimize stray current electrolysis action on this pipe line.

We understand the proposed water main will be a 48-in. cast iron line laid along Foxon Road, and therefore approximately parallel to the New Haven and Shore Line Railway tracks from North Branford to the junction of Foxon Road and Essex Street, Fair Haven. At the latter point the pipe line will turn into Essex Street which it will follow to Quinnipiac Avenue. At Essex Street and Quinnipiac Avenue, the new line will reduce to 42-in. and then continue by private right of way through the salt meadows bordering the east bank of the Qunnipiac River, crossing the river to Peck Street, New Haven. Along Peck Street, the new North Branford supply line will continue west to Blatchley Avenue where it will connect to a new 24-in. cross main which will run from Grand Avenue through Blatchley Avenue and Willow Street to Whitney Avenue.

Measurements of soil resistivity and of voltage gradients existing in the earth both parallel and at right angles to the proposed pipe line were made at the following characteristic locations:

1. In the salt marsh just east of the New York, New Haven and Hartford R. R. embankment (Shore Line Division).
2. In the high ground just west of Quinnipiac Ave.
3. On Essex Street in the high ground just east of Quinnipiac Ave.
4. On Essex Street approximately 500 feet east of Quinnipiac Ave.
5. Near the junction of Essex Street and Foxon Road.
6. At Foxon near the L. H. Goodrich property.

Soil resistivity tests were made at all of the above locations with the earth-current meter and the regular four terminal earth-current meter electrode inserted in a 2½-inch hole drilled in the earth to approximate pipe depth. Gradient tests were made at four locations with a Rawson voltmeter and a minal earth-current meter electrode inserted in the earth at points 100 ft. apart except at location No. 6 where the spacing had to be reduced to 50 ft.

The results of the tests are given in Table I.

It will be noted that in the salt marsh just east of the New York, New Haven and Hartford Shore Line Division railroad embankment the soil resistivity is exceptionally low averaging only 420 ohm-centimeters. In the slightly higher ground near Quinnipiac Avenue, the soil resistivity was extremely high, averaging 122,400 ohm-centimeters,

Table 1.—Earth Gradient and Soil Resistivity Measurements Along Route of Proposed North Branford-New Haven Water Supply Main, June 20-21, 1928

Location and Character of Soil	Average Soil Resistivity, Ohm-Centimeters	Earth Gradient Volts per Thousand Feet Parallel to Pipe Maximum	Parallel to Pipe Average	Transverse Maximum	Transverse Average
300 ft. west of Quinnipiac Avenue at Essex Street:					
Black meadow mud	420				
Essex Street, just west of Quinnipiac Avenue:					
Red sand and loam	122,400			2.3S 0.4N	0.83S 0.06N
Red sand and loam (60 minutes test)		10.0E 32.0W	3.4E 1.1W		
Essex Street (north side) just east of Quinnipiac Avenue:					
Red sand and loam	126,300	1.2SW	0.83SW	2.4NW 10.0SE	0.77NW 0.98SE
Essex Street (north side) 500 ft. Northeast of Quinnipiac Avenue:					
Red sand and loam	7,520				
Foxon Road, opposite Capella's Gas Station south of Shore Line tracks:					
Red sand and loam	70,600	3.0SW 0.4NE	0.77SW 0.03NE	6.8SE	2.0SE
Foxon Road, 75ft. east of Shore Line Pole No. 176 (L. H. Goodrich property) north of tracks:					
Red clay and sand	58,800	1.0E	0.61E	1.0S 200N	0.05S 8.8N
Red clay and sand (265 minutes test)				62.0S 282N	Neg. 23.0N

west of Quinnipiac Avenue, and 126,300 ohm-centimeters on Essex Street just east of Quinnipiac Avenue. About 300 or 400 feet further east, Essex Street runs through salt marsh and in this locality the soil resistivity averaged 7,520 ohm-centimeters. At Foxon Road and Essex Street, where the new pipe will run parallel and close to the New Haven and Shore Line tracks the soil resistivity averaged 70,600 ohm-centimeters while in the town of Foxon it averaged 58,000 ohm-centimeters.

The tests of voltage gradient in earth showed that in the vicinity of Quinnipiac Avenue there is an extremely high voltage gradient in earth at right angles to the Qunnipiac Avenue trolley tracks of The Connecticut Company, and therefore practically in line with the proposed pipe line. The maximum gradient along the line noted at the locations either side of Quinnipiac Avenue ranged from 1.2 to 32 volts per 1,000 ft., while the maximum gradient at right angles to the line ranged from 0.4 to 10 volts per 1,000 ft.

At Foxon Road and Essex Street the gradients were not as high as they were near Quinnipiac Avenue, but yet the maximum values ranged from 30 volts per thousand feet parallel to the line to 6.8 volts at right angles. At Foxon the maximum gradient parallel to the line was 1.0 volt, while the maximum gradient at right angles to the line exceeded 200 volts per thousand feet in the field north of Foxon Road near the L. H. Goodrich property. This occurred with a New Haven and Shore Line car operating in the immediate vicinity. To determine the actual maximum value attained by this gradient, a six-hour test was made with a special high sensitivity recorder and non-polarized electrodes. At the same time an eighteen-hour record of the potential of the trolley rails referred to earth six feet away from the rail was obtained. This gradient record shows a maximum of 282 volts per thousand feet at this location and the potential test showed the rails reversing to earth at times, becoming as much as 70 volts positive in potential to adjacent earth.

It is evident that at practically all locations where tests were made in the Foxon Road territory the voltage gradients existing in the earth were far in excess of the limitation of one volt per thousand feet ordinarily set for reasonably safe electrolysis conditions. In fact the earth gradients along the route of the proposed North Branford water supply line are so high that it would be practically impossible effectively to protect the proposed pipe line against stray current action under existing railway conditions. It is true that generally speaking the soil resistivity is comparatively high and that as a result the existing stray current density in the earth is low. This, however, would merely accentuate trouble on a metallically continuous pipe line which would have to run through the low as well as through the high resistance soil. Stray current interchange between such a pipe line and earth would be extremely localized in the soil areas where the resistivity was very low or moderately low.

In addition, the proposed route involves a long exposure to stray currents and since the pipe will be large in size and low in electrical resistance comparatively large amounts of stray current could be picked up even in the high resistivity soil. For this reason any attempt to break up the electrical continuity of the proposed pipe line with isolated insulating joints would be certain to result in high differences in potential across such joints. Even if every pipe joint were made insulating, a gradient of 32 volts per thousand feet parallel to the pipe, such as exists near Quinnipiac Avenue would mean a potential difference of 0.4 volt across each bell joint. Such a potential would be far too high for safety, with any of the practically feasible non-metallic pipe jointing materials like Leadite or Hydro-Tite.

The high voltage gradients existing in the earth in the Foxon Road territory can only be due to an extremely defective track return circuit system on the railway line in this area, and the obvious remedy is the elimination of these defects. In the case of the Quinnipiac Avenue line, we know that the crossing with the New Haven and Shore Line Railway was in bad condition, because an indicating voltmeter test showed a potential as high as 18 volts across this cross-over both in a north to south as well as in an east to west direction. In the case of the New Haven and Shore Line Railway, visual inspection of short sections of track indicated a large number of bonds missing, and the additional possibility of existing bonds having a high electrical resistance because of their being of the pin terminal type whose electrical conductivity is not always perfect to begin with and apt to deteriorate with vibration and age. Another factor tending to radically increase stray currents from the Shore Line system was the comparatively long direct-current feed existing at the time of our tests, due to the Totoket Substation of this trolley being out of service. Apparently this substation was not being operated regularly, and this meant that the entire New Haven and Shore Line Railway was being supplied from the Grand Avenue station of The Connecticut Company in New Haven and a New Haven and Shore Line Substation in Guilford.

Conclusions.—The ultimate safety of the proposed North Branford-New Haven water supply main from stray current hazards demands that the present abnormally excessive track drops existing on the railways in this territory be materially reduced and maintained at a small fraction of their present magnitude. This will involve (a) test of all rail bonds and special work jumper cables, (b) immediate replacement of all missing or defective bonds or special work jumper cables, (c) operation of the Totoket Substation of the New Haven and Shore Line Railway system at least during periods when cars are operating between North Branford and New Haven, and (d) thorough and continuous maintenance of the general electrical conductivity of the track return systems.

Assuming adoption of such railway return circuit improvements as will reduce track drops and earth gradients to reasonable values, it would be well to break up the electrical continuity of the proposed pipe line at several points on both sides of the Quinnipiac River before the line enters the low wet ground bordering the river. From the data which we have obtained so far, the best locations for insulating joints on the east side of the river would be in the high-resistance soil (a) near Essex Street and Foxon Road; (b) just east of Quinnipiac Avenue; and (c) just west of Quinnipiac Avenue. On the west side of the Quinnipiac River, we understand the line will run in clean river sand along the greater part of Peck Street, and several insulating joints should be installed in this section at locations where the soil resistivity is high and where the joints will not be by-passed by connections to the general water distribution system.

Since the expense of installing insulating joints when a pipe is being laid is comparatively small, we would also suggest the installation of additional insulating joints in the proposed pipe line about 500 ft. either side of the crossing with the New Haven and Shore Line track on Foxon Road near Eastern Street, and in the Town of Foxon at 1,000-ft. intervals along the section where the pipe will closely parallel the trolley tracks.

The electrical effectiveness of all insulating joints should be determined by test both just before and after they are put into the line in order to safeguard against breakdowns resulting from handling. All of the insulating joints and the pipe for a few feet on either side could be covered with an insulating coating of tar or asphalt to increase the length of the earth path around these joints. After the line is complete, tests should be made to ascertain whether or not dangerous shunting action exists at any of the joints. To facilitate the latter tests it would be well to install permanent electrical test stations, as the pipe is laid, approximately midway between each pair of insulating joints. On the river section of the main, one such test station should be installed 200 or 300 ft. west of the easterly insulating joint and another, 200 or 300 ft. east of the westerly insulating joint.

Acknowledgment.—The foregoing is an abstract of a paper presented before the New York Section of the American Water Works Association.

Construction of a Small Reinforced-Concrete Bridge

Span of T-Beam Design Built at Laconia, N. H.

By CHARLES A. FRENCH
City Engineer and Superintendent of Public Works, Laconia, N. H.

IN December of last year the city of Laconia, N. H., completed the new reinforced-concrete Church St. bridge, spanning the Winnipesaukee River. This is one of the most important stream crossings in the city and carries the Daniel Webster Highway, the central trunk-line highway of New Hampshire, which is subjected to very heavy traffic.

Replaces Old Timber Trestle.—The river at this point has been spanned since 1840 by a timber bridge resting on mud sills on the river bottom, with split stone abutments at either end resting on logs embedded in the river bed. It had been found necessary to renew this structure at frequent intervals, and the resultant expense and annoyance to traffic were considerable. A movement toward replacement of the old structure was begun in 1908, when Sanford E. Thompson prepared plans and specifications for a two-span arch bridge having a total length of 135 ft. and an over-all width of 50 ft. Since the permissible street grade was but 9.8 ft. above the level of the water, it was necessary to design very flat arches. The problem was complicated by the absence of favorable foundation conditions at the ends of the proposed span.

The city council failed to provide appropriate funds to carry out this project and ordered the reconstruction of the timber bridge, which was maintained with great difficulty until 1928.

Reinforced-Concrete Bridge Chosen.—In 1928, because of the increased flow of traffic and heavier loading, it was decided to construct a reinforced-concrete bridge suited to modern traffic conditions. Public sentiment demanded a structure of pleasing appearance at this point, which requirement eliminated some types that might have been built more cheaply.

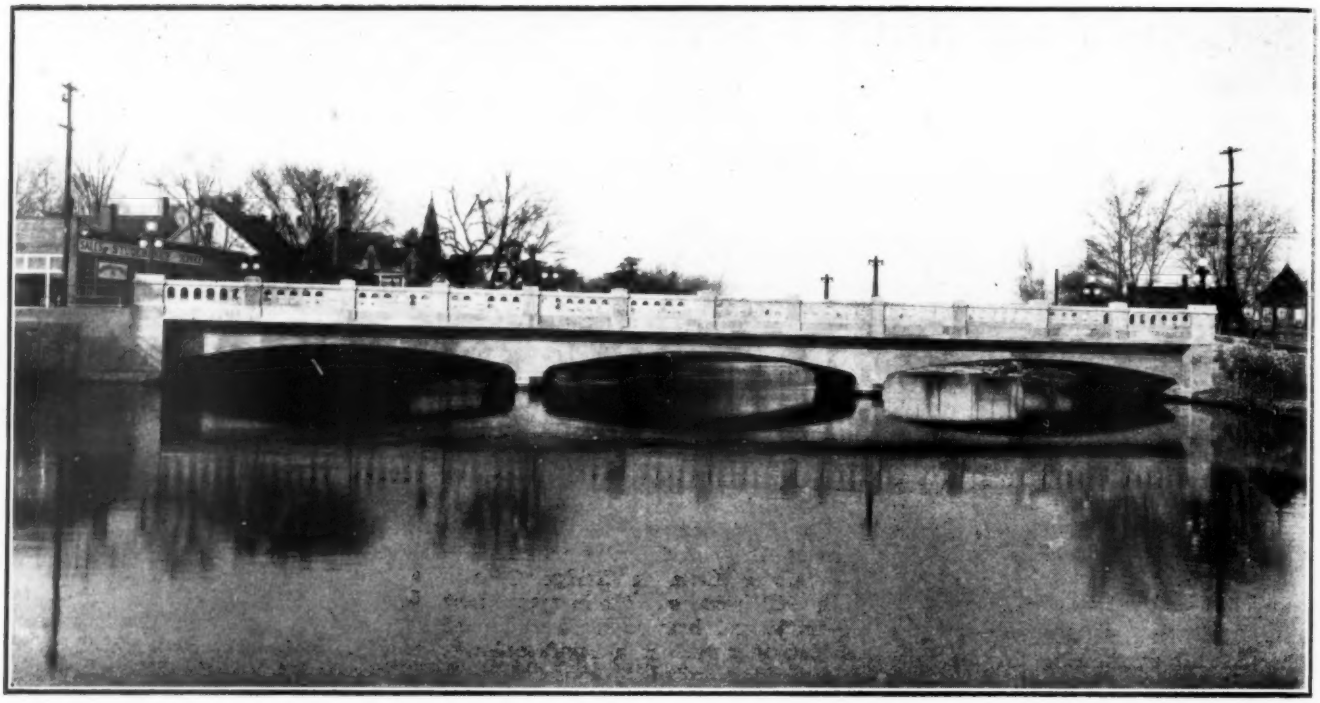
The department of public works had built previously two T-beam reinforced-concrete bridges at other locations with considerable success and, in view of the conditions existing at this site, it was decided to design a similar structure, to be built by the forces of the department. Because of the limited head room it was necessary to make the depths of the beams as small as possible. In order to satisfy the public demand for a structure of acceptable appearance, the exterior beams were made to resemble arches.

Borings at the abutments and at the pier locations indicated that a coarse gravel bottom existed at from 17 to 20 ft. below water level, overlaid by coarse sand, fine sand and silt, from 6 to 16 ft. in depth.

The river opening of 150 ft. was divided into three spans, each 46 ft. 11 in. in the clear. The bridge was designed for a 20-ton truck loading, with 30 per cent added for impact. The girders were designed as continuous beams, with an expansion joint provided at each abutment. No fill or special surface was provided for the roadway, but traffic was carried directly upon the slab. The concrete may be surfaced later if the wear seems to indicate that this is necessary.

The spans are carried on nine T-beams, 3 ft. 2½ in. in depth and 18 in. wide. The roadway slab is 7½ in. deep.

Church St. Bridge in Laconia, N. H., Carries the Daniel Webster Highway, an Important New England Trunk Line, Across the Winnipesaukee River



This Bridge Consists of T-Beam Spans, but the Exterior Beams Were Made to Resemble Arches in Compliance with the Public Demand for a Bridge of Pleasing Appearance

The slab is cantilevered for a distance of 3 ft. beyond the exterior beams to carry a portion of the sidewalk and the railing. Ornamental lamps are provided at the piers and abutments.

Construction.—It was necessary to close Church St. to all vehicular traffic during construction of the bridge. A foot bridge was built for the use of pedestrians. In general, limited space prevented the storage of much material at the site, and this hampered construction to a certain degree.

Considerable difficulty was afforded in the construction of the piers by a 12-in. sanitary sewer crossing the river through a cast-iron syphon, which conflicted with the location of the piers. Chiefly because of this sewer, it was decided to construct the piers and abutments in unwatered cofferdams. It was necessary to construct two cofferdams for each pier and abutment, as it was found that the material in the river bottom could not otherwise be held around the sewer when the cofferdams were dewatered.

An attempt was made to build timber cofferdams consisting of an inner and an outer shell with fill between, but it was found that the plank sheathing could not be driven deep enough to prevent the blowing up of the bottom of the excavation when pumped out. Lackawanna steel sheet piling was substituted for planking in the inside shells of the cofferdams, and this was successful in preventing blowouts. The cofferdams were excavated to suitable foundation material, which was found at an average depth of 15 ft. below water level.

The piers were built in two sections until the top of the sewer was reached, where the sections were joined into a continuous structure. Additional reinforcement was placed in the piers above the level of the sewer to tie the sections together securely and prevent any possible tendency to split above the sewer. There has been no indication of any settlement or movement of the piers or abutments since construction.

Local sand and crushed stone were used for concrete aggregate. The concrete was mixed in the approximate proportion of 1:2.5:3.5. About 6 gal. of water were used per bag of cement, and the proportions of aggregates were varied to secure a workable mixture for the various portions of the structure.

All forms, including forms for the balustrades, were fabricated on the job. The balustrades were poured in place. All exposed surfaces were rubbed with carborundum brick to remove form marks and secure a pleasing finish.

Work was commenced on April 20, 1928, and was finished Dec. 3. Traffic was allowed over the structure Oct. 17. The construction of the cofferdams for the piers was necessarily slow and accounted for a large part of the time consumed. Some delay was caused by cold weather in the latter part of November, which retarded the removal of the balustrade forms and the finishing.

Cost.—The total cost of the project was $43,932.60, divided as follows:

Demolition of old bridge; construction and removal of foot bridge	$ 664.75
Excavation and cofferdams	17,178.48
Concrete, forms, reinforcing, finishing	21,132.50
Engineering, overhead, insurance, miscellaneous	4,956.87
Total cost	$43,932.60

Personnel.—The bridge was designed by the writer, assisted by Miles N. Clair of the Boston firm of Thompson & Lichtner. Construction was under the supervision of the writer, with Hartley E. Hamm as construction foreman.

Modern Motor Fire Engines

Modern fire-apparatus units have many features in common with conventional motor vehicle practice but perform functions in no wise parallel to those of the ordinary motor vehicle, said Charles Fox, of the Ahrens-Fox Fire Engine Co., at a recent meeting of the Dayton Section of the Society of Automotive Engineers.

Motorization of fire departments began in a rather desultory way about 1910, and in time gasoline-powered fire engines "made good," considerably before the fact was conceded by the fire commissioners and chiefs. The way for complete motorization of the fire departments was paved by motor ladder-trucks, hose wagons, chemical engines and the like.

Three distinctly different types of pumps are now in general use on motor fire engines, according to Mr. Fox. These are the piston, the rotary, and the centrifugal types. The effect upon the powerplant incidental to the varying relation between volume and pressure is comparable, he said, with the varying load on the engine of an automobile when traveling on the road. When the pumps go into action, the volume of water discharged represents a moving weight, and the pressure at which the water leaves the pumps is the equivalent of a definite vertical height through which the weight is transported. Thus the volume and pressure constitute the load of the pump.

Zoned Municipalities in the United States

The Latest Government Report on Zoning Progress

MORE than 37,000,000 people, residing in 754 cities, towns and villages, comprising three-fifths of the urban population of the United States, now have the protection afforded by zoning regulations, according to a survey just completed by the Division of Building and Housing of the Department of Commerce. The zoned municipalities mentioned above include cities, towns and villages of various sizes and types located in all parts of the country. The results of the survey have been made public in the form of a bulletin compiled by Norman L. Knauss, and issued on April 1 by the Division of Building and Housing, of which James S. Taylor is acting chief. The notes following are taken from the bulletin.

Zoning Progress to 1928.—Viewing the progress of zoning in the United States from the standpoint of ordinances adopted, the eight zoned cities by the end of 1916 were augmented to 38 in 1920. The number of zoned municipalities was doubled in 1921, the total being 76. In 1922 New Jersey, New York, Illinois and Massachusetts showed considerable activity, the additions amounting to 101, which increased the total number of zoned municipalities to 177. During 1923, cities in California and Illinois were more active than in the preceding year, while cities in New York, New Jersey and Massachusetts were less active—but with other states zoning, many for the first time, the year netted 106 zoning ordinances and brought the total to 283. In 1924 76 municipalities adopted zoning ordinances; in 1925 there was increased activity in zoning legislation in the states of Connecticut, Indiana, Iowa and Pennsylvania, and zoning ordinances were adopted by 109 municipalities. Ninety-six municipalities zoned in 1926; 107 zoned in 1927; and 87 municipalities were reported having zoned in 1928; bringing the total number of zoned municipalities to 754.

Zoning During 1928.—Eighty-seven cities, towns and villages were reported to the Division of Building and Housing as having zoned during 1928; while 101 other municipalities were reported as having either adopted more comprehensive zoning ordinances or amended existing ordinance thereby making their zoning more effective.

An analysis of the 87 zoning ordinances reveals that 44 were comprehensive, regulating the use, height, and area of buildings; 27 merely controlled the use of buildings; seven regulated the use and area of buildings; and two were interim ordinances, adopted pending the more careful preparation of zoning ordinance looking to the future.

As a result of either the amendments or the revision of their zoning ordinances, 77 of the 101 zoned municipalities, that originally zoned prior to 1928, now have comprehensive zoning ordinances in effect.

Reports received from all parts of the country indicate a continuing zoning activity in all states. New York state not only leads with a total of 131 zoned municipalities, but also excelled all of the states in the number of municipalities zoned during 1928, with 23 zoned cities, towns and villages. Ohio and Pennsylvania were tied for second place, with six each.

Youngstown, O., Waterbury, Conn., and Altoona, Pa., were three of the largest cities which enacted zoning legislation. Cleveland, O., passed a comprehensive zoning ordinance on Oct. 1, 1928, but the ordinance was made inoperative on Nov. 26 upon the filing of a referendum petition thereon. A new ordinance, almost identical with the one repealed, was introduced on Nov. 16, but had not been adopted by the end of the year.

South Dakota and Idaho were added to the states having zoned municipalities when four cities in the former and three cities of the latter adopted zoning ordinances during the year.

Maryland and Georgia showed progress in county zoning. Prince Georges and Montgomery counties, Maryland, put comprehensive zoning ordinances into effect in areas adjacent to the city of Washington, D. C., and Glynn county, Georgia, adopted such an ordinance applying to its entire area. Township zoning in Pennsylvania has shown progress, with a comprehensive zoning ordinance for Radnor Township added in 1928.

Zoned Municipalities Grouped According to Population.—In grouping the zoned municipalities according to population it was found that 56 of the 68 largest cities having over 100,000 population (1920 Census) were zoned. The zoned municipalities in the population groups total as follows:

- 56 cities having over 100,000 population;
- 79 cities having less than 100,000, but more than 40,000 population;
- 86 cities and towns, having less than 40,000, but more than 20,000 population;
- 96 municipalities having less than 20,000, but more than 10,000 population;
- 132 municipalities having less than 10,000, but more than 5,000 population;
- 89 municipalities having less than 5,000, but more than 3,000 population;
- 119 municipalities having less than 3,000, but more than 1,000 population; and
- 97 municipalities having less than 1,000 population.

New York State Leads.—New York state still leads in the number of zoned municipalities. Massachusetts, New Jersey, Pennsylvania, Ohio, Illinois, Kansas, Wisconsin and California also rank high.

Most Active States Since 1916.—Ordinances regulating the height, and also the use of buildings were adopted prior to the enactment of the first comprehensive zoning ordinance enacted by New York City. Since then, the states showing the greatest zoning activity have been as follows:

- 1917—California, 4 zoned municipalities;
- 1919—California and Wisconsin, 2 each;
- 1920—New Jersey, 4; and California and New York, 3 each;
- 1921—New Jersey, 19; New York, 7;
- 1922—New Jersey, 30; New York, 22; Illinois, 10; Massachusetts, 8; and Ohio, 6;
- 1923—New Jersey, 19; Illinois and New York, 16 each; and California, 15;
- 1924—Illinois and New York, 13 each; Massachusetts, 10; California, 7; and Iowa and Pennsylvania, 5 each;
- 1925—Pennsylvania, 17; Massachusetts, 16; New York, 13; and California and Massachusetts, 8 each;
- 1926—Illinois and New York, 16 each; and Kansas, Massachusetts and Pennsylvania, 6 each;
- 1927—New York, 16; California, 12; Massachusetts, 10; Kansas, 9; and Pennsylvania, 8; and
- 1928—New York, 23; and Indiana, Ohio and Pennsylvania, 6 each.

States Having Most Zoned Municipalities.—When the states are listed according to the number of zoned municipalities, New York leads by a substantial margin, having a total of 131 zoned municipalities. New Jersey is second with 84 places; California, third with 73; Illinois, fourth with 71; Massachusetts, fifth with 62; Pennsylvania, sixth with 43; Ohio, seventh with 41; Michigan, eighth with 31; Wisconsin, ninth with 30; and Kansas, tenth with 23. Then follow Connecticut and Indiana, 17 each; Iowa, 14; Florida, 12; Rhode Island, 9; Missouri and Virginia,

8 each; Nebraska and Oklahoma, 7 each; North Carolina, 6; Colorado, 5; Alabama, North Dakota, South Dakota, and Tennessee, 4 each; Georgia, Idaho, Maryland, Minnesota, New Hampshire, Oregon, Utah and Washington, 3 each; Arizona, Arkansas, Kentucky and Maine, 2 each; and Delaware, District of Columbia, Louisiana, Mississippi, Nevada, South Carolina and Texas, 1 each.

Majority of Zoning Ordinances are Comprehensive.—An examination of the zoning ordinances of the 754 municipalities noted in the survey disclosed that 475 were comprehensive in scope, regulating the use, height and area of buildings. Of the 279 other zoning ordinances, most controlled the use to which buildings and premises could be put, although 45 of the number also controlled the area of buildings; and 10 others controlled the use and height of buildings.

Few Changes Made in Zoning Ordinances.—Questionnaires were sent to all municipalities throughout the United States having authority to zone under state zoning enabling acts. Most of the municipalities that had enacted zoning ordinances prior to 1928 reported that the early zoning ordinances were still in effect. A few cities stated that minor changes had been made in their zoning ordinances, as, for instance, the extending of the boundaries of the various districts, principally in regard to the use districts, wherein the use of buildings and grounds were controlled. A few others reported having revised their zoning ordinances as, for example, enacting a comprehensive zoning ordinance regulating the use, height and area of buildings, taking the place of an ordinance previously adopted which only controlled the use to which buildings could be put.

Considerable zoning activity was indicated by the returns from municipalities not yet zoned, and in returning the questionnaires, many of the city officials asked for information on the subject.

Court Decision on Permits for Garbage Transportation

An interesting court decision on the issuance of permits to remove and transport garbage in a city, is cited in the March 29 Public Health News. The decision was handed down Aug. 3, 1928, by the Ohio Court of Appeals in the case of the City of Cincinnati et al. v. State ex rel. Moock, 164 N. E. 771.

A section of the municipal ordinances of the city of Cincinnati provided as follows:

> That no person shall remove or carry in or through any of the streets * * * of the city * * * any house dirt or house offal, animal or vegetable, or any refuse substance, from any of the dwelling houses or other places of the city, or carcass of any dead animal, unless the owner of the same shall have procured a permit so to do from the director of public service * * * Provided, however, the provisions hereof shall not apply to any contractor with the city in relation to garbage * * *.
>
> It is hereby made the duty of the contractor with the city * * * to collect and remove * * * all garbage and refuse, animal, fish, or vegetable matter found within the city limits; and also all dead animals which are not removed or disposed of by the owner * * *. Except as herein provided as to dead animals, no other person or party than the city contractor or its agents shall carry, convey, or transport through the streets * * * such materials; and it shall be unlawful for any person to interfere in any manner with the collection and disposal of such materials by the city contractor.

The appellee brought a mandamus action to compel the city manager of Cincinnati to issue to him a permit to remove and transport through the city garbage and refuse. It appeared that the appellee had entered into an arrangement with certain hotels in the city to remove their garbage, for which he paid a small sum, and that he desired to convey the same through the city for feeding to his swine outside of the city. The city had an exclusive contract with a company for the disposal of all the garbage of the city.

The decision of the Court of Appeals sustained the refusal of the permit, such decision being summed up in the concluding paragraph of the opinion as follows:

> Our conclusion is that it is within the police power of the city to control the disposal of the garbage of the city in the way that it does; that the city manager did not abuse his discretion in refusing the permit and granting the exclusive collection to an individual corporation, and that there is no violation of any constitutional rights of the realtor.

To Reduce City Traffic Congestion

Discussing the questions of store-door delivery and reduction of city-street congestion, in the April issue of the S. A. E. Journal, George W. Daniels, of the U. S. Trucking Corp., states that the big manufacturing centers in New York City, such as the garment center, are innumerable congested points. Buildings in these districts house from 10 to 20 tenants each. Some receive one case at a time and others ten, and probably every tenant uses a different truckman. Often the goods are brought from mills having a truckman in the city who delivers for them. That adds other truckmen. Trucks are now loaded at night for the uptown section, and the man who gets to the door first is lucky. If he has to make two deliveries in one building, he can make one promptly, but while the receipt is being signed another truckman beats him out on the second delivery, so he loses from one-half hour to one and one-half hours to make the second delivery.

In any new building of more than one tenant the ground floor should be devoted, says Mr. Daniels, entirely to the receipt and shipment of merchandise, the raw material going into and finished products coming out of that building. There should be one truckman for each building. This man would bring all goods to that one building and he would use only one, two or three trucks where ten create congestion at present.

Ohio Sewage Conference

The third annual Ohio Conference on Sewage Treatment will be held in Canton, O. This decison was reached at a recent meeting of the Conference Executive Committee. Determination of the date was deferred, although two tentative suggestions were made—the week of Oct. 8 and the week of Oct. 22. The meeting will be held in the same week as the Ohio Conference on Water Purification, and dates mutually satisfactory will be selected soon, so timed that those who wish can attend both conferences. The water purification conference will be held in Columbus.

An ever-increasing interest on the part of municipal officials in sewage treatment and plant operation should assure a large attendance.

It is planned to expand the meeting into a two-day session and to include opportunity to inspect the Canton sewage treatment plant and the new Salem plant. The former, under supervision of Charles C. Hommon, formerly with the State Department of Health, comprises Imhoff tanks and trickling filters, and has been in operation about three years. The Salem plant embodies the most modern practice in the activated sludge process and is a new plant—the first of its kind in Ohio.

Collection of Garbage by City Held to Be Governmental Function

The Supreme Court of Oklahoma on April 3, 1928, handed down a decision of considerable interest to municipal officials. The decision was rendered in the case of Oklahoma City vs. Baldwin (273 P. 453) and is cited as follows in Feb. 1, Public Health Reports:

An action to recover was brought against the city of Oklahoma City, it being alleged that property damage and personal injury had been sustained by reason of one of the garbage trucks of the city health department having negligently hit the car of the plaintiff. A recovery was had in the trial court, and the city appealed. There was thus presented to the supreme court for decision the question as to whether or not a city, in collecting its garbage, was acting in a governmental or corporate capacity. The court decided that the city, when collecting garbage, was discharging a governmental function, in the performance of which the city was not liable for the negligent acts of its agents.

The contention was made that, because the city charged a fee for the removal of garbage, it was acting in its corporate capacity, but the court stated that it did not think the fact that there was a charge necessarily made the removal a non-governmental function so as to render the city liable.

Improving the Operation of Water-Treatment Plants in Maryland

State Department of Health Suggests Methods, Checks Results

CLOSE cooperation of the Maryland State Department of Health with the water-supply treatment plants of municipalities throughout the state has resulted in a definite improvement of the operation of these plants, with a consequent reduction in diseases traceable to a lack of adequate sanitary facilities. Periodical inspection of water supplies, education of plant operators, recommendations of routine tests to be made at the plants and the collection of detailed data concerning equipment and operation are the most important steps in the control of treatment plants in Maryland, as outlined by Abel Wolman, Chief Engineer of the department.

Public Supplies Inspected Monthly.—The state is divided into three districts, to each of which a resident engineer is assigned. In addition to his other duties he makes at least monthly inspections of the public water supplies in his district. Now and then a plant will require his attention at more frequent intervals and in some instances for several days at a time. On these visits samples are collected for analyses in the laboratories of the department.

Determinations Recommended to Operators.—The determinations recommended to be made by the plant operators depend upon the qualifications of the individual operator and the nature of the treatment the supply is receiving. When chlorination is required, the dosage is regulated by residual chlorine tests, the aim being to maintain a 0.20-part-per-million residual chlorine at an absorption period of approximately 5 minutes. Where, in addition to chlorination, sedimentation and filtration and possibly softening or acidity control are required, the application of the chemicals is regulated by the well-known jar test.

In recommending outfits for this work to a town, the materials required are listed, and the plant authorities are given the names and addresses of several concerns, when possible, from which they can be purchased.

For determining residual chlorine, the La Motte-Enslow comparator is generaly used. The set consists of six chlorine color-standards with values of 0.1, 0.2, 0.4, 0.6, 0.8 and 1.0 part of chlorine per million, made up in sealed ampoules; three 15-cc. test-tubes; an ampoule of distilled water; a 50-cc. bottle of ortho-tolidine reagent and a calibrated pipette for measuring the reagent. The equipment is contained in a wooden case approximately 8 in. long, 2½ in. wide and 5½ in. high. The top of the block contains three slots, backed by etched glass, for convenience and accuracy in making the test comparisons.

STATE OF MARYLAND
FILTRATION PLANT CENSUS

NAME OF PLANT _____ Date _____

Source of Supply _____

Plant: Type; Designed Capacity - M G D; Average Daily Delivery - M G; Date Installed

Mixing Basin: Number; Arrangement of Baffles; Capacity - Gallons; Velocity - Ft per Sec; Efficiency

Settling Basin: Number; Type; Capacity - Gallons; Displacement Time - Hours; Efficiency

Filters: Number; Size; Capacity - M G D; Rate Controllers (Type, Condition, Efficiency); Wash Water Troughs (Num Dist between Troughs Feet, Height of Troughs above Sand - Inches); Wash Water (Rate - Inches rise per Minute, Rate - Gal per Sq Ft per Minute, Source, Pressure - Lb per Sq In, Minutes used, Frequency); Sand (Depth - Inches, Effective Size, Uniformity Coefficient, Surface Condition, Mud Balls, Air Binding - in Winter, Air Binding - in Summer, Depth - Inches - Total); Gravel (Size - Each Layer, Depth of Each Layer, Evenness); Strainer System (Type, Condition during Wash (Even, Spouting, etc.), Troubles)

Condition of Appurtenances & Structures: Valves; Gauges (Rate Controllers, Loss of Head); Piping; Concrete

Chemical Equipment: Chemical Feeding Machine; Chlorinator (Type, Condition, Amount used, Residual Chlorine (5 Min Orthotolidine)); Alum - Gr per Gal; Iron - Gr per Gal; Lime - Gr per Gal; Soda Ash - Gr per Gal; Sodium Aluminate - Gr per Gal

Supervision: Manpower; Sampling; General Conditions in Plant

Operator _____ Designer _____

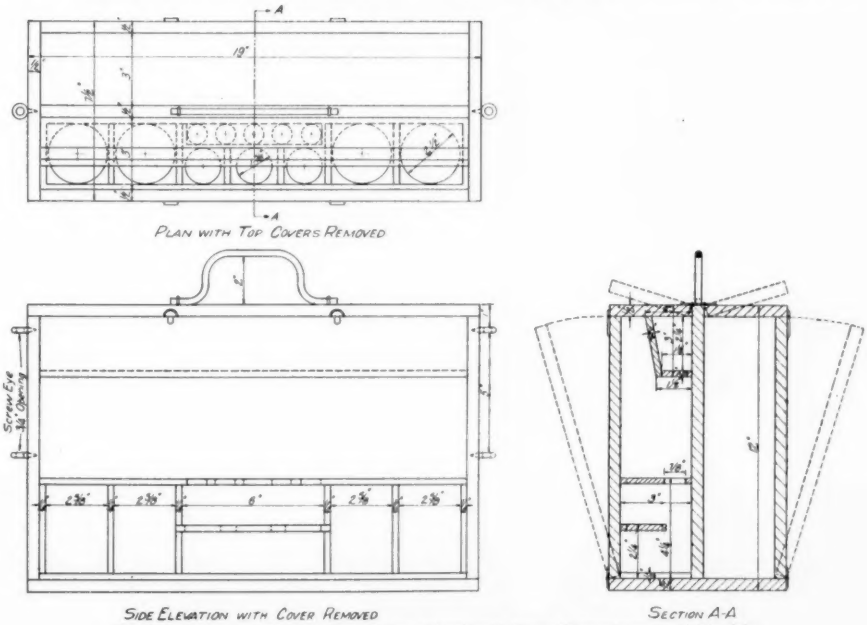
Remarks _____ Investigator _____

Form Used by the Maryland State Department of Health for Collecting Data on Filtration Plants

For hydrogen-ion concentration determinations, the La Motte block comparator, employing a colorimetric method, is most frequently purchased. The outfit is similar in design and size to the chlorine comparator described above. A knowledge of the general nature of the water acts as a guide in determining the pH range of color-standards applicable to a particular supply.

Field Laboratory Kit.—For the use of the department inspectors, there was recently devised a particularly satisfactory case for carrying the equipment necessary for field determinations of alkalinity, chlorides, CO_2, etc. The case, which is shown in an accompanying illustration, is 19 in. long, 7½ in. wide and 12 in. high. Although it was designed primarily for use in investigative work, it has been found convenient for demonstrations in instructing small plant operators and in enlisting the cooperation of town authorities.

Reports of Operators.—Accompanying are illustrations of an information sheet filled out by filter plant operators and a weekly report form submitted to the offices of the department. The purpose of the information sheet is to have on file, in convenient form, detailed data concerning each plant. These data are checked annually, although important changes that may occur at a plant are recorded at the time they are made. The data contained in the operators' weekly reports, as already suggested, vary in accordance with the nature of the treatment employed and the proficiency of the operator. Operators' re-



Field Laboratory Kit Designed for Maryland State Department of Health

FORM S.E. 51

Filtration Plant Operating Results

WEEK ENDING _____ 192 FILTER NO. _____ OPERATOR _____

		DATE						
RAW WATER		TURBIDITY—P.P.M.						
		ALKALINITY—P.P.M.						
		pH						
		TEMPERATURE						
FILTERED WATER		TURBIDITY—P.P.M.						
		ALKALINITY—P.P.M.						
		pH						
CHLORINATED WATER		pH						
		RESIDUAL CHLORINE—P.P.M.						
FILTER OPERATION DATA		WATER FILTERED—Gallons						
		FILTERS IN SERVICE—Hours						
		LOSS OF HEAD—Feet BEFORE WASHING						
	WASH WATER	GALLONS						
		PERCENT						
PUMP OPERATING DATA		PUMPS OPERATED—Hours						
		WATER PUMPED—Gallons						
CHEMICALS	ALUM	POUNDS PER DAY						
		GRAINS PER GALLON						
	CHLORINE	POUNDS PER DAY						
		PARTS PER MILLION						
		POUNDS PER DAY						
		GRAINS PER GALLON						

REMARKS:

Form of Weekly Report Submitted by Filter Plant Operators in Maryland Municipalities to the State Department of Health

ports are acknowledged with such comments as may appear desirable.

Large water treatment and sewage disposal plants are in charge of highly-trained operators who furnish monthly instead of weekly reports. These reports are, of course, in much greater detail than can be expected from the small-plant operators.

Department's Measures Successful.—A review of the typhoid fever record of Maryland seems to indicate that the efforts of the department of health in general are gradually being rewarded. The year 1928 showed by far the lowest typhoid fever incidence in the history of the state. The typhoid and para-typhoid fever mortality for the past year was 5.2 per 100,000 for the state at large, 4.2 for the city of Baltimore and 6.5 for the counties of Maryland. Ten years ago the rate for Maryland was 16.9 per 100,000. Systematic control over the public water supplies of the towns throughout the state may be held accountable for a good share of the decrease.

Political Interests Interfere. — In reckoning the amount of credit attributable to the measures of the State Department of Health here described, Mr. Wolman invites the attention of the observer to the not inconsiderable store of patience that must be brought to the business. Political and factional interests so frequently prove the controlling interests of a community that plant operators who have been fairly well trained have often failed in the past to live through municipal administrative changes. As a result, a good portion of the work of the department dealing with the education of operators and administrators must be repeated. However, those who have watched the progress of the campaign which is gradually spreading health information everywhere are confident that this adverse condition is being eliminated.

Research Work of Engineering Foundation

A science of humanics should be built up by research, it is declared in the annual report of the Engineering Foundation, made public by Director Alfred D. Flinn at 29 West 39th St., New York City.

"Experience," says the report, "is showing year after year the actual usefulness and the much greater possibilities of this joint research organization of our four senior national engineering societies with their 60,000 members.

"Even with small and uncertain resources, many members of these societies on special research committees are making valuable contributions of knowledge for the betterment of engineering and industrial practices. The public benefits, generally unaware.

"Research interests of engineers are not restricted to so-called material things. Improvement of the facilities for living and communicating lifts life steadily to higher intellectual, moral and spiritual levels, and promotes health, happiness and brotherliness. The engineer's studies must include the effects of his technical activities upon his fellow humans and their social organization."

During the year, according to the report, the Foundation continued its aid to researches concerned with arch dams, concrete arches, steel columns for bridges and buildings, blast furnace slags, electrical insulation, lubrication, engineering education, and painting of wood.

It also aided studies of fluid flow, cutting fluids used in cutting metals, engineering vocational selection, and other structural problems. Two new research projects are now under way. One relates to alloys of iron, and will embrace all forms of irons and steels. The other involves the materials, manufacture, and use of wire ropes.

The report tells of the Foundation's increased resources, and of its plans to raise further endowment, saying:

"Since 1915, the Engineering Foundation's capital funds have grown from $200,000 to $620,000 and its income from less than $10,000 a year to more than $30,000. This small income has been supplemented by cash, services, materials, and facilities, worth in the aggregate several times as much, contributed to projects which the Foundation has aided.

"These statements, however, are not the whole story. A number of engineers and other friends have let it be known that their wills contain direct or conditional bequests, and the number is increasing. These prospects for the future are encouraging.

"An Endowment Committee, appointed by the United Engineering Society for the Founder Societies has for members sixteen prominent engineers with Colonel E. A. Simmons, member of the American Society of Civil Engineers and the American Society of Mechanical Engineers, as chairman.

"This Committee is seeking $5,000,000 for the Engineering Foundation, and $2,000,000 for the Engineering Societies Library by direct gifts of cash or securities, bequests, life insurance, annuities, living trusts, or installment contributions.

"Projects in hand or waiting need substantial funds now; therefore, the Foundation especially invites the attention also of persons preferring donations for expenditure within a stipulated period, believing that the future will be at least as able as the present to provide for its own needs."

Testing Small Water Supplies in Rural Districts

The engineering Division and Division of Laboratories of the Ohio State Department of Health, cooperating with the district health commissioners, are endeavoring to inspect, analyze and report on the condition and safety of the public and semi-public small water supplies found in the rural districts and to mark with the Seal of Safety those found satisfactory. The form of the marker now used to identify safe supplies is a decalcomania of the State of Ohio outlined in yellow. In the center of the design is a yellow disc bearing the words "State of Ohio, Department of Health," near its outer edge, and "Seal of Safety" across the center. Above the yellow disc are the words "Safe Water." The field of the design is printed in gold.

Old Brick Pavements Relaid in Jacksonville

Methods and Costs in Florida City

By W. E. SHEDDAN
City Engineer, Jacksonville, Fla.

THE practice of laying vitrified brick pavements on natural subgrade with sand filler and without special foundation was followed quite generally in Jacksonville. Most of these pavements were constructed from 15 to 30 years ago and have served to carry traffic far in excess of that for which they were designed. With modern traffic and the motoring public demanding smooth riding pavements, city officials are faced with the need for rebuilding these streets and thoroughfares. Our study of this problem in Jacksonville led us to two definite conclusions:

1. Most of these pavements were not of sufficient width to meet modern traffic requirements.
2. The old brick had a definite salvage value and our examination of them indicated to us that from 60 per cent to 85 per cent were usable.

Salvage Quantities High.—The city of Jacksonville had some 50 or more miles of these pavements. It was recommended that certain streets be rebuilt with wider roadways. Forty, fifty and sixty-foot widths were selected, which conform to more or less standard widths used in this city. We are now completing this program and find that we somewhat underestimated the salvage quantities on all streets.

It was found that certain limited areas, constructed 30 or more years ago of small-size brick which were not figured of value in our relay program, actually produced more than 50 per cent reasonably good brick. These brick are usable for repair purposes and could be relaid on suitable foundations for light-traffic streets.

Other streets that have had from 18 to 25 years' service produced salvage quantities of usable brick averaging 75 per cent, and on some streets the salvage quantities exceeded 85 per cent. All these were "repress" brick approximately 3 in. x 4 in. x 8 in. in size which were originally laid on edge but in the relay program were laid flat. They cost when purchased from $21 to $25 per thousand, delivered in Jacksonville and the cost in place was from $1.25 to $1.60 per sq. yd., which is approximately 60 per cent of the present prevailing price.

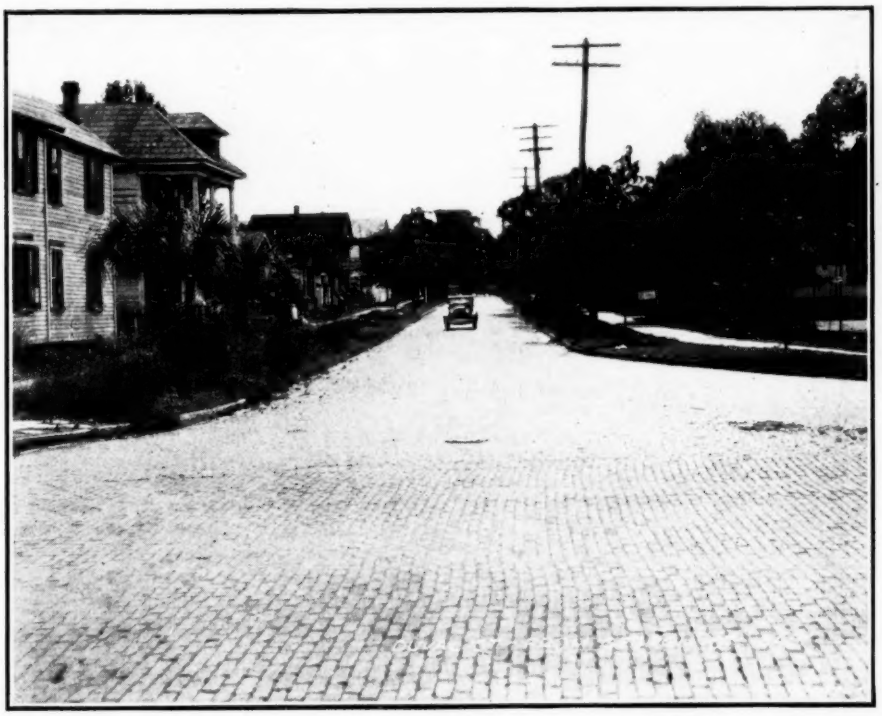
Relay Bids Close and Low.—The relay program comprises approximately 55,000 sq. yd. or about 2½ miles of 40-ft. roadway. All pavements were relaid on 8-in. compacted Florida limerock base with sand cushion and standard bituminous filler. The old granite curbs were reset, new 20-ft. radii being used.

When this work was advertised the city was fortunate in getting a large list of responsible contractors to bid. The bids were close and low. The prices bid by the three lowest bidders for relaying with standard brick filler on limerock base ranged from 30 ct. to 45 ct. per sq. yd. The prices bid for base, which includes grading and adjustments, were from $1.06 to $1.29, and resetting of old granite curb ran from 11 ct. to 13 ct. The prices bid for new brick, 3-in. vertical fibre with bituminous filler, were from $1.62 to $1.93 with about the same range for base and curb.

The relay projects have more than fulfilled our expectations as to smoothness and general appearance.

Relaying Methods.—The bituminous filler was applied in the ordinary way. One contractor used pouring cans, heating his bitumen in ordinary 500-gallon kettles; another used the ordinary 500-gal. kettles for heating, the bitumen being distributed direct from the kettles by attaching a hose and letting it drag on the brick and spill out. The kettles were pulled with a roller. Both contractors used hot metal squeegees for spreading and cutting the bitumen on the brick surface.

The relay brick required an average of 13½ lb. of bitumen per sq. yd. and the new brick an average of 11½ lb. per sq. yd.



An Old Brick Pavement in Jacksonville Before Relaying. This Shows Duval St., Looking East from Georgia St.

Economy of Relay Program.—We figure that the over-all average cost per square yard for completed pavements on the seven relay projects was $2.44 and the over-all average cost per square yard for completed pavements on the new brick projects was $3.05, showing a difference of 61 ct. per sq. yd. This amounts to a saving to property owners and the city of $33,550 on the seven projects.

The cost shown for new brick is the cost after the salvage value of the old brick taken from these streets has been deducted. This salvage actually amounts to an average of 33 ct. per square yard, which would make the cost of new brick based on these bids $3.38 per square yard, showing that the savings are about equally divided between the streets from which the brick were taken and the streets on which they were used.

In figuring the cost of the relay

Old Brick Relaid on Market St., Jacksonville. This Pavement Was Relaid on an 8-In. Compacted Limerock Base with a 1-In. Sand Cushion and Bituminous Filler

brick, the value of the brick already on these streets and used in the relay was not shown; only the brick added to fill out added width were charged.

Saving was not only effected on the relay streets but also on the streets from which the brick were taken up and replaced with new materials. We credited to the streets from which they were moved, all usable brick at $20 per thousand; this effected from 85 ct. to $1 per front foot saving on these streets. The work was all done on a one-third—two-thirds plan, the city paying one-third of the total cost from bond issue funds and assessing two-thirds of the total cost to abutting property on a per-front-foot basis.

Duval County has utilized this plan in rebuilding county highways, having relaid approximately 30 miles of 16-ft. road on a somewhat similar specification, with about the same results.

Meeting of New York Section Am. W. W. Assoc.—The next meeting of the New York Section of the American Water Works Association is to be held May 2nd and 3rd, 1929, at the Mark Twain Hotel, Elmira, N. Y. Secretary, E. D. Case, The Pitometer Co., 50 Church St., New York, N. Y.

Pacific Northwest Water Works Men to Meet.—The next meeting of the Pacific Northwest Section of the American Water Works Association will be held May 15th and 16th, 1929, at Spokane, Wash. Secretary, Kenneth Shibley, 1005 Securities Building, Seattle, Wash.

Regulations Governing Missouri Public Water Supplies Revised

The regulations of the State Board of Health of Missouri governing public water supplies have been revised recently. The most radical change relates to the bacteriological analysis of public water supplies. As authorized at the present time this applies only to those public water supplies which do not have adequate laboratory facilities.

The present policy of the State Board of Health recognizes that the most satisfactory plan includes a bacteriological water laboratory in conjunction with all surface water purification plants. Until such a condition exists, the new regulations provide for weekly analyses of all public water supplies which require purification and have an adequate laboratory control. Also, regular bacteriological and chemical analyses by the State Board of Health are required for all ground water supplies.

Section 10, Part VI, of the Sanitary Code, governing the analysis required of public water supplies is quoted herewith from March Missouri Public Health News, the official publication of the State Board of Health.

Analysis of Water Required.—Samples of water from public water supplies shall be collected as authorized by the state board of health and examined bacteriologically and chemically at the laboratories of the state board of health. Not less than two samples of water for bacteriological examination and one sample of water for sanitary chemical analysis shall be collected each year from the ground water supplies which do not require purification. Not less than one sample of water each week for bacteriological examination and one sample of water each year for sanitary chemical analysis shall be collected from surface water supplies and ground water supplies that require purification.

The following rules shall govern the analyses of water samples required by this regulation:

(a) Submission of Water Samples. Water specimens for sanitary analysis shall be submitted in containers, furnished by the State Board of Health. Specimens shall be collected and packed in accordance with instructions enclosed in the container. Specimens which are not collected and packed as specified shall be discarded.

(b) Transportation Charges on Specimens. The owner submitting specimens to the State Board of Health Laboratories for analysis shall pay all transportation charges on said specimens. When specimens are submitted in containers which must be shipped by express, the owner submitting the specimens shall pay the transportation charges both from and to the State Board of Health Laboratories.

(c) Fees—Authority For. By virtue of the authority conferred upon the State Board of Health by Section 5778, Revised Statutes of Missouri, 1919, the following fees are established for the sanitary analysis of water specimens as required by this regulation.

(d) Fees—Public Water Supplies. Basis of Charges. 1. The annual fee for the required sanitary analysis of public water supplies, shall be based upon the last estimate of population made by the United States Census Bureau.

2. When the regular sanitary analysis of a public water supply is instituted later in the year than the month of January, the fee for the remainder of the year shall be prorated by months on the basis of the annual charge. The fees for sanitary analyses of water shall be paid in advance.

3. Ground Water Supplies. The fee for the required sanitary analyses of public water supplies of ground origin which do not require purification shall be as follows:

Population of Cities	Per Year
Under 500	$12
500 to 1,000	13
1,000 to 2,000	14
2,000 to 3,000	15
3,000 to 5,000	16
5,000 to 15,000	17
15,000 and above	18

4. Surface Water Supplies. The fee for the required sanitary analyses of public water supplies of surface origin and ground water supplies which require purification shall be as follows:

Population of Cities	Per Year
Under 1,500	$ 40
1,500 to 3,000	60
3,000 to 6,000	80
6,000 to 10,000	90
100,000 and above	100

Elevated Storage for Municipal Water Supply

Considerations in Selection of Elevated Storage Capacity

By DONALD H. MAXWELL

Principal Assistant Engineer, Alvord, Burdick & Howson, Consulting Engineers, Chicago, Ill.

MANY water works plants are undoubtedly under-developed in provision for elevated storage, while a few have perhaps unnecessarily liberal capacity. There appears to be in fact great diversity of practice in this respect.

Disadvantages of Operating Without Elevated Storage.—There are many disadvantages, particularly in the relatively small plant, of operating without elevated storage. The principal disadvantages are the following:

1—With direct pumping, it is necessary in order to maintain pressure to keep the pumps in operation at all times, at a rate equal to the demand. Interruption in power or other failure of pumps or supply at once results in an abrupt pressure drop and cessation of service. This result is always a severe inconvenience and may in case of fire be disastrous.

2—The necessity of following the demand curve with the pumps requires more consistent attendance at the pumps, especially with steam equipment, and does not permit of as good economy as would be possible by operating pumps of the proper capacity at their best efficiency.

3—From the standpoint of good pressure on the distribution system, following the demand curve with the pumps has a disadvantage in that at high pumpage rates, the friction losses between the pumps and consumers necessarily result in lowered pressure. It follows that satisfactory pressures are easily maintained on the distribution system at night and during the early morning hours of low pumpage when not so important, whereas pressures are necessarily less satisfactory during the hours when water is used at a high rate and good pressures would be particularly desirable.

4—With electric pumping, following the demand curve has the further disadvantage of building up a high peak power demand with corresponding unfavorable effect on the power bill. Direct pumping also precludes taking advantage of off-peak power rates, which usually involve a substantial saving.

Purpose of Elevated Storage.—Part or all of these objections to pumping direct may be obviated by elevated storage, the purposes of which may be summarized as follows:

1—To tide over interruption in pumping.

2—To smooth out peaks in demand, both for water and power.

3—For fire protection.

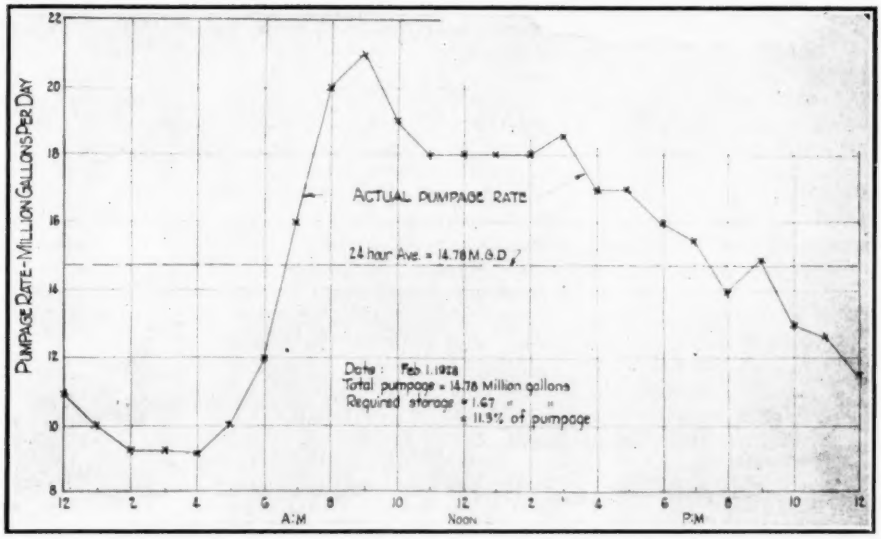


Fig. 1.—Pumpage Characteristics on Typical Approximate Average Day

4—To improve pressures.

Capacity of Elevated Storage.—The requirements for the above purposes vary widely with the size and type of plant.

In the small town a single elevated tank of moderate capacity may serve all of the above purposes economically.

In the larger plant, it may be better economy to provide a portion only of the desirable reserve as elevated storage. In very large plants, with steam operation and more than one pumping station, elevated storage becomes of less importance for reserve, but even here may be distinctly valuable to improve pressure distribution. The first step to a rational solution is a consideration of the proper basis for determining the storage capacity to meet each of the purposes listed above.

Tiding Over Interruptions in Pumping.—To meet the contingency of power interruption, the elevated storage

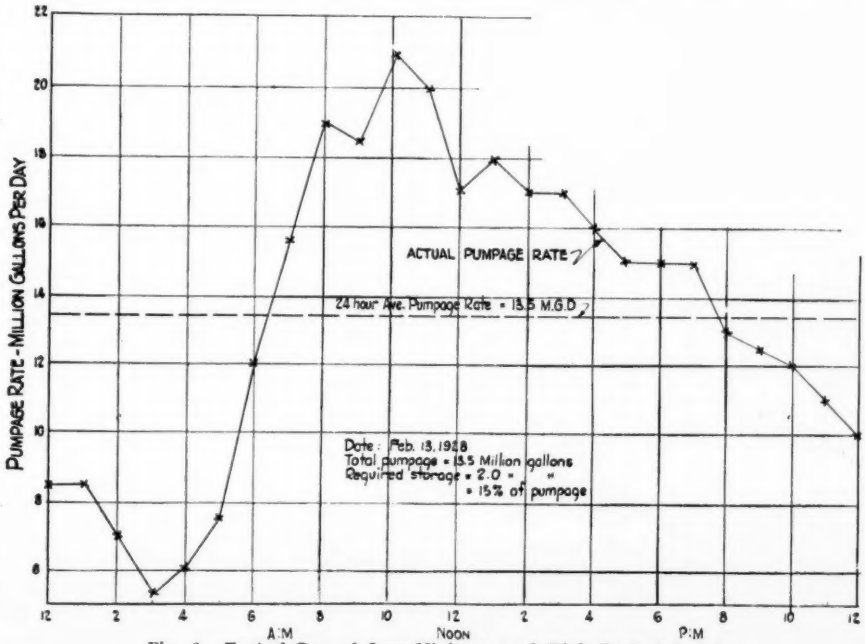

PUMPAGE RATE - MILLION GALLONS PER DAY
ACTUAL PUMPAGE RATE
24 hour Ave. Pumpage Rate = 13.5 M.G.D.
Date: Feb. 13.1928
Total pumpage = 13.5 Million gallons
Required storage = 2.0 " "
= 15% of pumpage
A.M
Noon
P.M

Fig. 2.—Typical Day of Low Minimum and High Peak Average

should be sufficient to supply the ordinary consumption demands in the interval required for starting the emergency equipment. With electric pumping, this requirement is the minimum that should be provided. Preferably the storage should be extended when practicable so as to reduce dependence on stand-by pumping equipment.

Smoothing Out Peaks With Elevated Storage.—For the purpose of smoothing out the peaks in consumption demand, the required amount of elevated storage is approximately 15 per cent of the 24-hour pumpage rate, in fully metered towns with an average consumption of approximately 100 gal. per capita per day. This will vary with the pumpage characteristics of the particular plant and should be determined in relation thereto. Fig. 1, 2 and 3 illustrate the characteristics in a manufacturing city of about 160,000 population.

Figure 1 represents a typical approximately average day.

Figure 2 shows a typical day of low minimum and high peak pumpage. This shows a minimum rate of 5.3 m.g.d. and a maximum rate of 20.9 m.g.d., the maximum being nearly 400 per cent of the minimum rate.

Figure 3 shows three typical days of heavy pumpage.

On each of these diagrams there is indicated the elevated shortage required to permit the pumps to supply the demand at a uniform pumpage rate.

Leaving out of consideration future growth, the desirable amount of storage is this instance to make uniform pumping practicable is approximately 2 million gal., or about 15 per cent of the 24-hr. pumpage rate.

Smoothing out peaks of the pumpage rate has the following advantage:

1—In connection with electric pumping, it reduces the cost of power by lowering the peak rate of power demand.

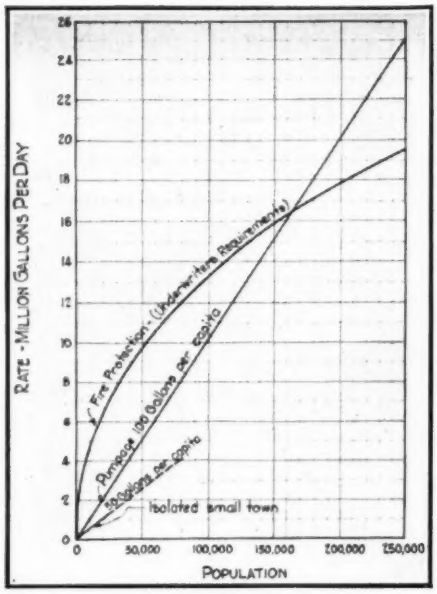


Fig. 3.—Three Typical Days of Heavy Pumpag

2—It reduces the cost of power, whether steam or electric, by permitting operation of properly selected units at maximum efficiency.

3—It increases the efficiency of the distribution system, permitting more uniform pressures to be maintained and providing higher pressures than otherwise possible during peak periods of consumption.

Off-Peak Pumping.—In plants operating on electric power, including cities with suitable high service reservoir sites as well as smaller towns, it may be good economy to include in elevated storage sufficient capacity allowance for shut down of pumps during the on-peak power hours.

Storage for Fire Protection.—In the small plant pumpage rates for fire protection are high relative to the average pumpage for ordinary consumption. This is clearly shown on Fig. 4, which shows the maximum fire demand rate in comparison with ordinary consumption rates, based on 50 gal. and 100 gal. per capita respectively.

The small plant with a well supply usually cannot furnish the quantity required for fire protection economically, except from storage. In such plants having air lift and in small plants with filtration, a large part of the necessary reserve is frequently carried as low level storage, but this has the disadvantage of too great dependence on pumps and power service, in emergency.

It is practicable in the small plant, and more satisfactory to provide all or a major part of the necessary reserve as elevated storage. This also applies to cities, which have suitable high level reservoir sites.

The storage capacity provided for fire protection should preferably be sufficient to supply the rate of flow called for by the underwriters' requirements, for 10 hours in cities over 2,500 population, and for 5 hours in cities under this population.

Depth of Storage.—Depth of storage should not exceed the permissable pressure variation. Storage below the level corresponding to the minimum pressures maintained, is wasted except as it may be of some value in extreme emergency. Such storage may not entail added cost but where not used is misleading if considered as useful storage.

Location of Elevated Storage.—Elevated storage may be utilized to improve the efficiency of the distribution system, and give better distribution of pressures. This purpose is best served by locating such storage remote from the pumps, and generally speaking, on the opposite side of the principal district served. In this way heavy drafts at intermediate points are supplied from opposite directions, thereby greatly reducing the pressure losses for given flows and correspondingly improving the pressures. To illustrate, if the flow is supplied at a point midway between pumps and elevated storage equal quantities being supplied from each source, the pressure loss at the point of use will be only one-quarter of the corresponding loss if the entire flow is furnished directly from the pumps.

Provision for Future Growth.—Provision of elevated storage should be made adequate for at least ten years in the future, just as would be done with any other major plant improvement. For this purpose, the trend of growth in pumpage and the probable conditions at least ten years in the future should be taken into account.

Acknowledgment.—The foregoing is an abstract of a paper presented at the recent meeting of Rocky Mountain Section of the American Water Works Association.

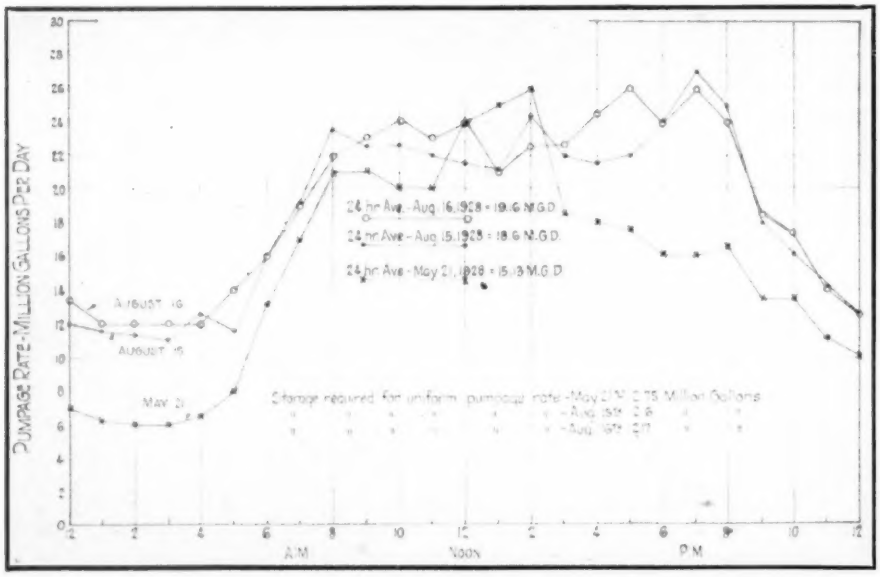

PUMPAGE RATE - MILLION GALLONS PER DAY
24 hr Ave - Aug 16 1928 = 19.6 M.G.D.
24 hr Ave - Aug 15 1928 = 18.6 M.G.D.
24 hr Ave - May 21 1928 = 15.3 M.G.D.
AUGUST 16
AUGUST 15
MAY 21
A.M.
NOON
P.M.

Fig. 4.—Maximum Fire Demand Rate Compared with Ordinary Consumption Rates.

City Planning As Related to the Smaller Cities

General Procedure and Related Legislation Outlined

By E. A. WOOD
City Planning Consultant, Dallas, Tex.

IN adopting a comprehensive program for its work the National Conference on City Planning has urged each American municipality to do three things: First, provide a city plan commission and office where the commission may take part in the city's administrative machinery; second, prepare and adopt an official city plan; third, secure public support for the administration of the official plan. Such a program may be adapted to any municipality irrespective of size, location or composition. It also clearly shows that the difference in city planning in large and small cities is one of size only. The principles are the same and legislation is equally necessary in either case. There is this difference however—that city planning is easier for the smaller cities to undertake; is more effective, and does not cost nearly so much as in the larger cities.

All cities should be as carefully planned as a modern railway terminal, a suspension bridge or a central lighting plant. But the planning should be done before the city is built. And it should be along regulatory lines before mistakes occur rather than through the corrective method after errors have been permitted. Therefore, if the official plan is prepared in advance of city growth, its enforcement becomes a matter of public support strengthened by the necessary rules and regulations to make it effective in all parts of the city.

Planning Commission First Step.—As pointed out by the National Conference on City Planning, the establishment of a city planning commission is the first step in the planning of a city. Since private property and property rights are involved, a commission is better able to deal with the public than the mayor and board of commissioners. The latter do not have the time to devote to the many problems that arise, nor are they politically free to treat the subject dispassionately. The planning commission should be created by a properly drawn ordinance to give the required official status. Preferably the ordinance should be patterned after "A Standard City Planning Enabling Act," as prepared and published by the United States Department of Commerce.

This act was prepared by an advisory committee whose members have each had many years of first-hand experience in coping with local planning problems, both as citizens and in connection with the leading national business, professional and civic groups which they represent. During the three years' work required to draft the act, the advisory committee made laborious researches into legal problems and consulted with expert planners, members of planning commissions, municipal officials and other interested persons throughout the country. The act, therefore, represents the very best city planning thought, is concise yet brief, and contains the necessary legal phraseology.

Enlist Public Interest.—The relationship of city planning to the smaller city should be real. It should create a lively interest on the part of every citizen. The membership of the planning commission should be carefully selected and should be composed of outstanding citizens who can devote a considerable amount of time to the study of physical conditions on the ground as well as to the numerous meetings that will be required with different groups of individuals. The memberships should be varied and since the plan is to be comprehensive and include all phases of city life, the public schools, park board, women's clubs, chamber of commerce and retail merchants should be represented along with other organizations. Representatives from the city government should be limited to a member of the council and the city engineer. The former should act as a liason agent between the council and the planning commission, and the latter is entitled to membership by virtue of his office. He is also charged with the execution of the plan and to some extent with the enforcement of the commission's rules and regulations. The mayor and city attorney should be members ex-officio, the mayor by virtue of being the head of the council, and the city attorney by reason of his legal training.

The ordinance creating the city planning commission should also establish a budget to provide for the establishment of a city planning office, and the employment of a city planning consultant. The former is necessary to provide working quarters for the commission, a meeting place and a forum for the creation of interest in the official plan. Public interest in the plan is of prime importance, and it is necessary that someone explain the plan, exhibit maps and discuss advantages both pro and con if public interest is to be sustained. Many people respond by giving counter proposals, and thus interest is aroused and held if the work progresses expeditiously. In the smaller city, it is easier to create this interest and hold it because the diversity of objectives common to the big city is lacking. Also, the opportunities for correct planning are more numerous in the smaller city; at least the physical boundaries are more elastic and are more readily molded into the official plan.

Master Plan Essential.—But one must ever be on the alert for mistakes. Therefore, a city planning consultant should be employed, not only to guide and direct the planning, but also to serve as mentor to the city planning commission and the citizens. It is very easy to make mistakes, and early enthusiasm for city planning benefits may lead to serious errors unless held in check by the consultant. The making of a master plan is a matter involving not only all of the land within the city boundaries, but affecting all of the land adjacent to the limits. Therefore, study of an area larger than the city is necessary for the preparation of the master plan.

After the city planning commission has been established and before work has been started on the master plan, there are a number of city planning regulations that may be put into effect. The most important of these are the platting requirements and the zoning ordinance. An early enactment of the platting rules is very desirable because of the failure of individual land owners to coordinate their subdivisions with existing streets, alleys and blocks. This is not due so much to willful neglect as to the lack of foresight and the absence of a master plan to serve as a guide. Coordination of all plans is the outstanding feature of a master plan.

Platting of Property.—The planning commission should prepare and adopt a set of rules governing the platting of property at its earliest opportunity, so that it can exercise the necessary supervision over the individual property owners and coordinate individual efforts. These rules should lay down clearly and concisely the kind of plats to be submitted for approval, together with the scale of the drawing and the information desired. It is necessary that a certificate of ownership be furnished together with ties to existing corners, to locate the property on the master plan. Such rules acquaint the public with the commission's function and methods. To be effective they should also be adopted by the city commission. This gives them legal status.

In Texas, cities of 25,000 population and over now have the power to control platting, not only within the city's

limits, but also for a distance of five miles beyond. In cities of less than 25,000 population, control within the city limits can be obtained by withholding water, sewer or other utility connections until plats conform to the master plan. Continuous streets of proper width without offsets and without dead ends and with blocks of economical size can thus be secured and the plan gradually carried out.

Develop Parks; Preserve Trees.—Additional features might be added to these regulations which would be helpful to the master plan. These are building lines for residences, setbacks for stores adjacent to home areas and the dedication of fractional lots for park purposes. Certain cities now require property owners to dedicate 10 per cent of their additions for park purposes to assist in the development of a park and playground system.

Parkways, boulevards and walkways should be located along creeks and rivulets. The parkway feature is extremely important because it not only furnishes an adeqaute storm sewer system but also adds to the beauty and utility of additions, spreads out the population and reduces the danger from fire. Too frequently this type of regulation is overlooked and subdividers are permitted to fill up dry runs and storm channels, including these in the lots and selling to private owners who have no interest in maintaining them as public ways.

Trees and shrubs are usually found along such channels. These should be preserved as an asset to the city not only from the aesthetic standpoint but also from the utilitarian standpoint of shade and playground space. Natural beauty spots can rarely be improved upon except by cutting out underbrush and making them available to the public.

Establish Building Lines.—The establishment of building lines in residential districts adds materially to the privacy of homes, decreases the dust nuisance, decreases the noise from passing traffic and encourages home beautification through the planting of grass, trees, flowers and shrubs. They decrease the accident hazard to children by providing suitable playgrounds on every lot. They also permit vision clearance for traffic at street intersections.

In suburban and outlying business districts the building line or "setback" permits cars to park "head-in." This gives greater freedom to traffic. It not only removes the parked vehicles from the moving lanes of traffic but also provides for future street widening.

Zoning Ordinance a Prime Requisite.—Zoning regulations should also be enacted before the preparation of the master plan. These deal with the use of private property and not only restrict the ues of the land, but also limit the height of buildings and the density of population. Three general types of usage are recognized in zoning regulations; viz., residential, commercial and industrial—the former being the most restricted use while the last is the least restricted.

In the early days of city life property classifies itself along economic lines and following certain economic laws. Industries and warehouses are established along the railways, while the banks, hotels and stores form a group around the public square. Beyond the stores are the homes of the people. Zoning follows these same laws and prohibits the intermingling of industry, commerce and dwellings. Homes may be built in commercial or industrial districts but commerce or industry can not invade home districts nor can industries invade business districts.

This type of regulation is legal not only in Texas but in the majority of the states because it is based upon the police power of the government which seeks to protect the health, safety, morals and general welfare of the community. This authority was given to Texas cities by its legislature in 1927.

Zoning regulations are meeting a popular demand on the part of home owners for protection. This popularity is shown by the following table showing the number and class of cities in the United States having zoning regulations.

Population	No.
Less than 1,000	53
1,000 to 5,000	144
5,000 to 10,000	102
10,000 to 25,000	103
25,000 to 50,000	79
50,000 to 100,000	47
Over 100,000	55
Total	583

Zoning is an essential part of the master plan. Land is divided into two general classes: public land and private land. The master plan must deal with both classes and unless some measure of control is exerted over the privately owned land, correct city planning cannot be had nor can proper provision be made for the expansion of streets and public utilities.

Once the character of the various sections of the city is established by zoning, the street plan, the park, boulevard and playground sytem, the school locations and the civic center can be designed and laid out as an integral part of the master plan which gives the picture of the future city. Of course it will need to be expanded from time to time and even supplemented or changed. Nor will the work of the city plan commission ever be finished. It will continue from one year to the next, attempting to provide plans in advance of actual growth.

Public Must Favor Plan.—Public support is necessary for any city plan and the master plan must be sold to the public, else it will never be carried out. Experience in many cities bears out this statement and it is sometimes said that it is better to have more selling and less planning. At any rate, the essential point is to sell the community on the advantages of planning and a master plan. Citizens will then demand the plan before they will permit the expenditure of public funds for uncoordinated work. This is particularly true of the smaller cities whose public funds are limited.

Acknowledgment.—The foregoing is a paper presented at the spring meeting of the American Society of Civil Engineers at Dallas, Tex., on April 25.

The Planning Foundation of America

When the movement for better city planning began to gather headway in the 1900's, the needs and problems of the cities' congested populations and movement were recognized as appalling enough to demand the establishment of a central forum for their discussion and formulation. In 1910 the National Conference on City Planning was organized. As the planning interests of the country expanded, the Conference became the center for research, advice and information to the extent of its limited financial resources.

But there is no easy solution for these grave municipal problems, and the necessity for an adequately equipped central organization devoted solely to the study and guidance of city and regional planning in the United States has been increasingly apparent. Frederick J. Keppel, president of the Carnegie Corporation, in his annual report for 1928, points out that each year's experience "reinforces the conviction that additional foundations are needed, particularly of relatively limited objective, and not necessarily of large capitalization;" and quoting from his annual report of 1926, Mr. Keppel specifies among other requirements studies in rural life, in recreation, and in town and regional planning.

It was proposed, therefore, in 1928, to erect a Planning Foundation to expand the service program already operated by the Conference, and with the larger resources of such a foundation increase the service of the Conference in proportion to the planning needs of the country.

The Planning Foundation of America will not teach people how to pave streets or build private houses and city halls. It will not instruct them how to finance the acquirements of parks, or the enlargement of water supply systems. Capable agencies exist for these purposes. The Foundation's object is to bring together the facts, figures and experiences of city and regional planning, wherever they exist, study them, coordinate them, and place them at the disposal of the public as authoritative planning guides. When the problems of city planning are so treated the movement for orderly city growth will reach its goal on a sound economical basis.

New Safety Zones Protect Pedestrians and Trolley Passengers in Toronto

Electric Beacons of Unusual Design Installed

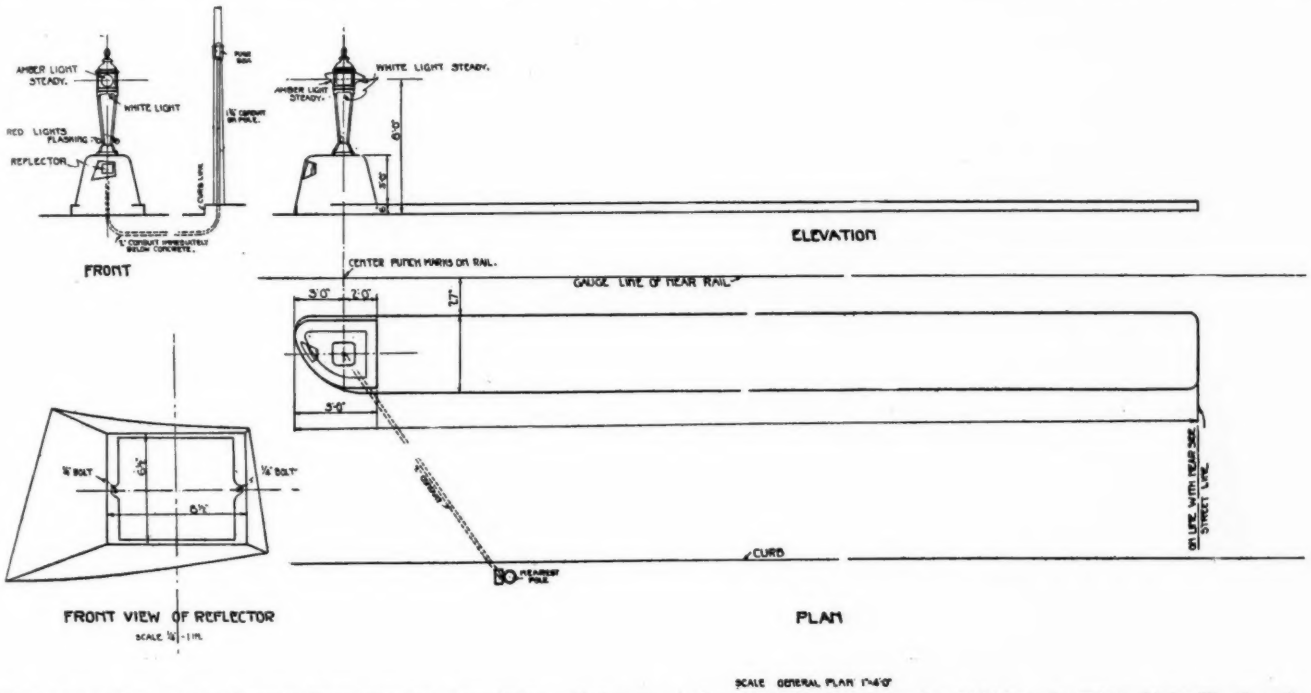
A RECENT contribution to the safety of pedestrians and street car passengers in Toronto, Ont., is the system of safety zones installed on St. Clair Ave., between Bathurst and Dufferin streets. The installation of beacons and concrete loading platforms has been a decided success, according to H. W. Tate, Assistant Manager of the Toronto Transportation Commission, who furnished the information here presented.

City, Commission Divide Cost.—In the latter part of 1928 the Toronto Transportation Commission reconstructed 1¼ miles of double track on St. Clair Ave. with its standard paved construction, where previously there had been open tracks and a boulevard strip. At this time an agreement was entered into by the city and the commission, providing for the construction of safety zones at the various car stops within the reconstructed section by the city, and furnishing and maintenance of lighting beacons by the commission. Under this arrangement 20 safety zones were constructed, the commission furnishing the city with the design of platform and buttress.

Design of Zones Based on Tests.—The original design called for an overall length of platform of 105 ft., to accommodate the standard length of train operated, but this dimension was shortened to 55 ft. by the city. A width of 4 ft. 6 in. and a height of 6 in. above the adjoining pavement were decided upon after a careful study of safety zone installations in a number of American cities. A distance of 2 ft. 3 in. from the near rail to the face of the platform gives proper clearance for the rolling stock operated by the commission.

Tests were made using a dummy platform, to insure that the clearance distance of 2 ft. 3 in. and the height of 6 in. above the pavement in no way interfered with the speed of loading and unloading and that no risks to passengers were introduced in these operations. The accompanying drawing shows the location and dimensions of the zones.

Construction of Beacon.—The beacon frame consists of a cast-aluminum housing, mounted on four tubular supports which are bolted to the concrete base. Three distinct optical units are provided in the beacon: one to attract the attention of oncoming traffic, one to light the loading platform and one to illuminate the concrete buttress at the base of the beacon pedestal. The aluminum housing contains these three units as well as a flashing motor. Doors are provided to give access to the units within. The height from the top of the concrete pedestal on which the beacon is mounted to the center of the lens is 4 ft. 6 in. At the base of the beacon are arranged two ruby globes, protected by guards and connected to the flashing motor. A red glass reflector is installed in the front of the concrete buttress as an additional safeguard in the event of a failure of the lighting supply.



New Safety Zone of the Toronto Transportation Commission. Notice the Amber Light Facing Oncoming Vehicles, the White Light Flooding the Loading Platform, the White Light Illuminating the Concrete Buttress and the Red Flashing Lights

Three-Purpose Optical System.—The optical units installed in the housing utilize two side faces and the bottom of the casting, and operate on a steady current.

For oncoming traffic there is provided a square condensing refraction amber lens having an illuminated area of 8x8 in. For lighting, a lamp of from 60 to 100-watt size is utilized. The lens is capable of distributing the light laterally over a wide angle. A visor is provided.

The system used for floodlighting the platform is placed on the opposite side of the beacon from the amber lens. A round lens of clear prismatic glass, 8⅜ in. in diameter, is employed. Illumination is provided by a 60-watt traffic signal lamp and a parabolic reflector. This entire system is rendered dustproof and weatherproof by means of rubber gaskets.

The concrete buttress supporting the beacon pedestal is illuminated through a lens in the bottom of the housing. This unit is essentially of the same arrangement as the unit used for flood-lighting the platform, utilizing a square refraction round lens, gasketed into the bottom of the housing.

Beacon on Two Lighting Circuits.—The lighting units in the aluminum housing are on the street lighting circuit, while the two flashing lights mounted near the base of the pedestal

How the Beacon Appears to Oncoming Vehicles. The Ruby Globes Near the Base of the Pedestal Flash Continuously and the Red Glass Reflector in the Concrete Buttress Is an Additional Safeguard in the Event of a Failure of the Lighting Supply

are on a commercial circuit, allowing continuous operation. The flashing mechanism consists of a small 110-volt motor, with attached switch of the mercury tube type. The ruby globes flash once a second. The beacon is connected to the nearest curb pole by a 2-in. conduit carrying lead-covered cable, laid under the roadway. The beacons were supplied by the Canadian General Electric Co.

Cost of Installation and Maintenance.—The cost of each zone, complete with beacons, was approximately $700. It is believed, however, that future installations will not cost more than $600, as a number of development charges were included in the first cost. The cost of lighting will be about $1.50 per month and the cost of electrical maintenance $1.00 per month, making a monthly charge of $2.50 per zone.

Installation Pleases Public. — The zones have received many favorable comments and are freely used by pedestrians crossing from one side of the street to the other as well as by the car passengers. Vehicular traffic is allowed to proceed with caution past the zone while a car is loading and unloading and, as no curb parking is allowed opposite the zone, there is no doubt that vehicular traffic is speeded up.

Costs of Refuse Disposal by Various Methods

The cost of any particular method of refuse disposal varies greatly with the composition of the refuse and such local conditions as labor prices and the market for waste products. Some unit costs are given below as an indication of what has been done under various methods of disposal. These figures are reprinted from the advance proof sheets of a report of the Committee on Regional Plan of New York and Its Environs.

Feeding to Swine.—The operating cost of the Worcester, Massachusetts, hog farm was $2.65 per ton of garbage in 1917. The return from the sale of hogs was at the rate of $6.85 per ton of garbage, yielding a profit of $4.20 per ton. The city of Los Angeles, Cal., under its contract entered into in 1921, receives $0.60 per ton of garbage after loading on railroad cars.

Dumping at Sea.—The cost to New York City of dumping garbage at sea after loading at the waterfront dumps was about 15 ct. per cubic yard in 1924. There were 494 tows handled that year and the dumping ground was about 42 miles from the Battery during the summer months and several miles nearer during the winter.*

Garbage Reduction. — In Rochester, N. Y., 34,700 tons of garbage were treated during 1925 by the Cobwell reduction process, at a total cost, including operation and capital charges, of $9 per ton. By-products produced a revenue of $6 per ton, making a net cost of $3 per ton. Excluding capital charges, this amounted to $1.55 per ton net cost which it was hoped to reduce to $0.75 in 1926.†

The Cleveland, O., reduction plant, which averaged $1.70 per ton profit between 1915 and 1920, has been particularly successful. It shows the possibilities of this method under favorable circumstances and efficient operation. From 1921 to 1926 this plant operated at a loss, due to comparatively low prices received for grease and the high rate of wages paid. In 1926 this loss amounted to only 13 ct. per ton. These figures all include depreciation but no capital charges.

Incineration.—Statistics for 1925 for incinerating plants of Toronto, Can., indicated a total operating costs, less carrying charges, of $1.50 per ton, at a plant which handled about 50,000 tons annually of mixed garbage and rubbish, and $1.11 per ton at another plant handling about 63,000 tons.‡ An incinerator constructed in Buffalo, N. Y., in 1926, has been handling about 360 tons daily at a cost of $1.61 per ton.

To decrease the cost of incineration it is interesting to analyze the possibilities of the generation of steam. A modern high temperature destructor will furnish sufficient heat for the evaporation of 1 to 2 lb. of water per pound of refuse burned, depending upon the composition of the materials, in addition to any preheating of air required for the furnace operation. One ton of mixed garbage and rubbish per hour should generate 1,750 lb. of steam, or about 50 boiler horsepower. Assuming generator efficiency of 87 per cent, the developed horsepower would be 44.5 per hour or 33.2 kilowatts per hour. For a 200-ton plant on a yearly basis this would be 50,000 tons×33.2=1,660,000 kilowatt-hours. Electricity could be sold at approximately 1 ct. per kilowatt-hour or $16,600 per annum. If the electricity could be utilized for lighting and general purposes in New York City municipal buildings, it would save a present expense of approximately 5.40 ct. per kilowatt-hour, or $89,500.

The first basis, i. e., incineration without production of steam, would give an estimated 1925 unit cost of incineration of $2.36 per ton of garbage and rubbish. With production of steam on the basis outlined above, the unit cost of incineration would be $0.57 per ton of garbage and refuse.

Itemized costs have been computed based on labor charges obtained for certain incineration plants in New York City in 1925. For a 150-ton plant, handling 110 tons of refuse per day, the following labor was required:

1 Stationary engineer at $8.50 per diem	$ 8.50
6 Firemen at $6.50 per diem	39.00
3 Garbage Stokers at $5.50 per diem	16.50
2 Ash pickers at $5.00 per diem	10.00
2 Watchmen at $5.00 per diem	10.00
Total labor cost of disposal of 110 tons of refuse	$84.00
Labor cost of disposal per ton of refuse	.76

Similar figures for a 100-ton plant, handling 75 tons of refuse, showed a labor cost of $0.74 per ton of refuse. Taking into consideration all items of operation and maintenance, the following approximate subdivision of cost per ton was obtained:

Labor	$0.76
Other maintenance and operation costs	.06
Interest on investment at 6 per cent	.60
Amortization	.24
Depreciation	.24
Total cost per ton	$1.90

Beccari Method.—It has been estimated that the cost per ton under the Beccari method of disposal would be about $1.13. If a market should exist for the residual humus, this treatment might be expected to yield a profit.

*Mr. Kenneth Allen, Transactions, American Society of Civil Engineers, Vol. 91 (1927), page 839.
†Mr. John V. Lewis, ibid., pages 828 to 836.
‡Mr. J. A. Burnett, ibid., page 827.

The Maintenance of Small Water Meters

Important Features and Methods Used at Hartford

By H. W. GRISWOLD

Designing Engineer, Board of Water Commissioners, Hartford, Conn.

THE maintenance of its meters is always a live problem with the management of every water utility, and as the number of its meters and the cost of their maintenance increases, it becomes more and more important to so conduct the business that, on the one hand, too much revenue is not lost from out-of-repair meters, and that, on the other hand, too much is not spent on the upkeep of the meters themselves. Many factors must be considered in deciding upon a meter maintenance policy which will be balanced properly between these two extremes, which will meet the requirements of the public utility commission or other supervisory body, and will not produce an undue number of complaints from customers.

The First Item of Maintenance.—Meter maintenance really begins with the uncrating of the meter at the utility receiving room for the methods of handling as well as the type and kind of setting have considerable influence on the subsequent performance of the instrument. Rough handling and exposure to extremes of heat or cold are not good for any make of meter and are to be avoided always. Some utilities make a flow test on new meters before putting them into stock or into service. This serves not only as a check on the manufacturer's product but detects any meters that may have been damaged in transit or after delivery.

Setting Meters.—In setting meters two general methods are followed. One is to set the meter in the cellar of the building served as close to the point of entry of the service pipe as possible. The other is to set the meter in a box or vault at the street line. Which is the better form of setting depends on climatic conditions—how often the meter is to be read—against whom the cost of the meter setting is assessed—the length and kind of pipe serving the building—and the type of building. With either type of setting brass tail pieces or one of the numerous patented types of settings may be used. At Hartford, most of the settings are in the cellars of buildings, and all new meters are tested before being set.

Meter Costs at Hartford.—The costs of the different operations for the various sizes of meters are tabulated below.

The cost of the meter and all of the meter costs incurred up to and including the first setting are properly chargeable to capital outlay, so that from an accounting standpoint, maintenance costs may be said to start as the meter setting team drives away.

Many Ramifications of Maintenance Problem.—The problem of meter maintenance has a great many interesting ramifications and it is interlocked to a greater or less extent with practically all of the other activities of the utility, but, considered alone, the most efficient method of maintenance is the one which gives a minimum sum for the cost of keeping a meter in operating condition on each service, plus the value—at the established rates—of the water which passes through the meters unregistered. The maintenance cost item in turn is the sum of the costs of the various kinds of work that go to make up the job of meter maintenance, and of these operations, some must be performed regardless of cost, while others may be curtailed or extended as desired or as funds permit.

Repairing and Changing Meters.—A large part of the work and a part that must be carried on continually, is the changing and repairing of meters reported as "Down" or "Not Operating" by the meter reading or inspection force. The stoppage of the meter may be due to plugging with rust or some other foreign substance, to mechanical trouble in the meter or injury from freezing or from hot water. To remedy the trouble from any of these causes the meter must be removed from the service and taken to the shop for repairs. At Hartford a crew of two men with a light car are used for changing meters. For many years it was the custom to take off a meter, put a pipe nipple in its place, and when the meter had been repaired at the shop to make a second trip to put the same meter back on the service from which it had been taken. During the last year or two it has become the practice to take off a "down" meter and immediately to put on a new or repaired meter in its place from a small stock carried on the meter truck. This saves the second trip to the service and while it increases the clerical work somewhat, the net result has been a reduction in cost.

Shop Procedure.—In the shop, two methods of procedure seem to be in general use. In the smaller shops one man does the whole work of repairing and testing a meter. In the larger shops one man cleans and dissembles the meter; a second inspects it, decides what repair parts are needed and requisitions them from the stock room; a third man assembled the meter with the new parts and adjusts it; a fourth man tests it, and a fifth man paints it and makes it ready for the stock room or for setting. This procedure follows in general the standard factory method of splitting up a task into a number of operations of which the individual worker performs but one. Some shops replace gear trains and registers as units and have one or more men whose job it is to repair these parts only.

Stock Room Practice.—A stock of parts for each make of meter to be repaired at the shop must be carried, and the tendency is for this stock to grow unduly large if not carefully controlled. Where only a few meters of one make are in use, it is sometimes cheaper to carry no parts for them but to ship the meters of this make to be repaired back to the factory. The stock room practice usually follows that in use for the withdrawal of other material than meter parts from stores although some utilities do not keep a stock ledger for meter parts and do keep a ledger for main pipe and service pipe material. It is true of course that a meter stock consists of a great number of very small parts having a low price per unit and that the clerical work necessary to carry on a complete stores account for meter parts is a much larger percentage of the value of the stores than is the case with either main pipe or service pipe supplies.

Meter Testing.—In testing either new

Meter Costs for 1928 at Hartford, Conn.

Size—	⅝ in. Per Meter	¾ in. Per Meter	1 in. Per Meter	1½ in. Per Meter	2 in. Per Meter
Testing new meters	$ .29	$ .31	$ .56	$ .52	$ 4.25
Installing in buildings	3.37	3.84	4.84	8.41	9.30
Changing in buildings	1.35	1.50	1.38	3.36	8.11
Repairs and test (used meters)	4.45	5.20	7.81	12.30	18.40
Building Meters:					
Installing	3.95	.....	.....	.....	.....
Replace with permanent meter and repair and test building meter	10.04	.....	.....	.....	.....
Number of Meters Handled					
New meters tested	275	400	78	50	3
Installed (new) building	241	300	52	40	5
Box	21	25	6	.....	.....
Changed in buildings	753	745	187	25	21
Used meters repaired	914	843	213	31	30
Building meters	517	.....	.....	.....	.....

or repaired meters one of the several makes of meter testing machines is very generally used together with the necessary tanks and scales for determining accurately the quantity of water passed by the meter. A machine which tests one meter at a time usually suffices for a small shop but as soon as more than three or four are working on the repair of meters a machine that will test meters in groups of from five to eight is found to be more satisfactory.

Meter Records.—Meter records are an essential part of any successful scheme of meter maintenance, but the cost of these is apt to mount along with the stock room costs if not watched. Records, no matter how interesting, which are not summarized at frequent intervals nor used regularly in the conduct of the business should be viewed with a critical eye. No system can function without some form of work order, which is often made to serve as a report of the job when completed. All meter work must be reported in detail to the meter reading department in order that the meter readers' books and the consumers' ledger may be kept straight and up to date, for it is on these in the last analysis that the utility depends for its income—the most important thing in many ways in the whole business. Whether it pays to keep a record of the kind, number and size of meter on each service or to keep a history card for each meter on which is noted all its goings and comings, the amount of water it has passed to date, all the tests that have been made on it and the cost in detail of each operation, are questions which have as many different answers as there are utilities. These meter life histories are interesting to study, but from an operating standpoint it would hardly seem worth while to keep such close track of a $10 to $15 article unless such records would pay for themselves in pointing the way to economies in maintenance or in determining the most efficient make of meter to purchase. The latter use of the history is the one most often stressed, but it is doubtful if many meters are actually purchased on the strength of the records made by the early—and now obsolete—models of that make of meter.

Minor Meter Repairs.—There are certain repairs that can be made without removing the meter from the service. Chief among these are stuffing box leaks and the replacement of the register glass cover. By having the meter readers note the nature of the trouble in reporting a meter "down" it is possible to have these repairs in place taken care of by one man with a light car to take him from job to job, and thus a large part of the expense of taking off and replacing the meter is avoided.

Meter Reading. — The frequency of reading meters is a factor to be reckoned with in meter maintenance. The cost of reading meters for billing purposes alone is not properly a maintenance charge, but often meters are read one or more times between billing dates for the dual purpose of detecting "down" meters and of locating meters which show excessive consumption so that the owners of the property may be notified and may either take steps to stop the excessive use or waste or be prepared for an unusually large bill at the end of the period. The cost of these intermediate readings is in part at least chargeable to meter maintenance and if the interval between readings is short enough it will be unnecessary to make additional inspections of small meters in place. In Hartford the small meters are read every two months and the bills sent out every six months. Large meters are read and billed monthly. Interesting data on the current practice regarding meter readers and meter reading in other southern New England cities are shown in the tabulation.

Data on Meter Readers and Meter Reading in Southern New England Cities

Number of Meters	How Often Read	No. of Readers	Hours Worked Week	Rate of Pay	Meters Read per Man	Other Work Done
5,490	3 mo	2	44	$30 wk	100	Remove and Reset
7,560	big 1 mo sml 3 mo	10 { 4 6	54	$32 wk	75-90	Inspect Leaks
9,480	3 mo	3	44	$5.75 d	60	None
9,950	Abt 45 d	3	44	$32 wk	90	None
13,980	Hse 3 mo Com 1 mo Big 1 wk	4	48	$5.04 5.36 d	125	None
15,390	big 1 mo sml 1.5 m	....	41.5	$5.00 d	50	None
22,000	1½ mo	6	41.5	$38 wk	100	Inspect Leaks
22,400	big 1 mo sml 3 mo	8	44	$36	90	Inspect for Meter Repairs
24,110	big 1 mo sml 3 mo	6	44	$30 wk	90-100	None
27,662	Monthly	10	40	$42	100	None
41,276	3 mo	10	44	$24-$30	85	Inspect
96,460	big 1 mo sml 3 mo	31	38	$25-34	49	None

It seems to be generally conceded that meters, even though they are apparently operating perfectly, should be removed, tested and repaired at intervals in order to keep them within reasonable limits of accuracy. In some states—Connecticut among them—this interval is determined by a ruling of the Public Utilities Commission or similar regulatory body, and varies from about five to ten years. The lower figure is for Connecticut and the higher for New Jersey. In some cases the maximum quantity of water that shall be passed by a meter between regular tests as well as the time interval between tests is specified. For any utility not covered by a definite ruling regarding regular tests, the proper interval between tests could be determined from the costs of changing and repairing a meter, the rate charged for water, and data on the average performance of the makes of meters in use in the community over a period of years. The first two items are known or can be readily ascertained but even where meter histories are kept it is not easy to construct a performance curve that will be truly representative. Factory tests show that a meter may register on a 1/32-in. stream after passing a million cubic feet of water. In general, however, it may be said that meters do not register more water than passes through them—consumers to the contrary notwithstanding—and that the longer meters run the less accurate they are—the decrease in accuracy being a function both of the time in service and of the quantity of water passed.

Conclusion.—In conclusion, and as a summary, it may be said that the five factors which have the most effect on the cost and efficiency of small meter maintenance are:

1—Frequent inspection of meters in service to detect those not registering and those over-registering.

2—The prompt removal and replacement of "down" meters with a minimum of lost motion.

3—The testing of all meters at regular intervals.

4—The application of efficient factory methods to the repair shop and the testing bench.

5—Close control over records and stock so that there will be enough—but not too much.

Acknowledgment.—The foregoing is an abstract of a paper presented April 10 at a spring meeting of the New England Water Works Association.

Minnesota Water Works Men Meet in June.—The next meeting of the Minnesota Section of the American Water Works Association is to be held jointly with the Minnesota League of Municipalities, June 12th to 14th, 1929, inclusive, at Austin, Minn. Secretary R. M. Finch, Wallace & Tiernan Co., 240 South 4th St., Minneapolis, Minn.

How to Secure Better Bituminous Macadam

The Importance of Watching Details in the Progress of the Work

By WILLIAM J. DOUGHERTY
Secretary-Engineer, Park Commission, Portland, Me.

IT may be of some interest to those who are engaged in building bituminous macadam, or who may, in the future, have this class of work to do, to offer some comment bearing on this type of construction which we are reasonably sure to have to construct in New England, at least, for some time to come. There is probably not one of the present accepted standard types of improved surfacing which has been more abused in construction, and which has varied so much in the degree of satisfaction attained as has this bituminous type. We can most certainly place a great deal of the trouble with, or the apparent shortcomings of this type of pavement, to that real enemy to good construction, the personal element or equation, if you like.

While the writer realizes full well that bituminous penetration construction cannot take it splace side by side on the economic scale with some of the really heavy duty pavements, such as reinforced concrete, sheet asphalt on concrete base and the stone block types, yet there is very much that can be offered to show that penetration macadam has an important role to fill in the development of any comprehensive highway system in New England and many times elsewhere.

Salvaging Old Roads. — The wisdom of salvaging many of the worn-out macadam roads and many times the seasoned and treated gravel roads which are the results of progressive road building steps and to make these serve as foundations for bituminous pavements has been stressed repeatedly in highway writings. It is this very factor of seasoned depth of good foundation material that should make us alert to the economy of surfacing the road with bituminous pavement. Penetration construction appears to be the recognized type for usage with foundations as above described. We should be very reluctant to "scrap" a very valuable base road, if there is possibility of restoring it and making it conform to the grades and contours of the new pavement.

The Personal Item.—The writer has at times noted a marked indifference on the part of some officials, charged with highway work, to put real heart into bituminous penetration construction to get all there is of value into the pavement and this when it is found that neither the traffic to be served nor the funds at hand warrant the selection of a more rigid and more expensive type. Mention of expense prompts me to say that under conditions often met in practice, bituminous penetration can cost considerably more than concrete pavement if you have to prepare an adequate base. Due to the necessity of deep base construction required ordinarily for bituminous macadam, by comparison to reduced thicknesses of bases (with just as much effectiveness) required for concrete pavements, it is many times wiser to accept the reinforced concrete pavement at a higher cost per square yard than to attempt a thoroughly new and adequate build-up for bituminous macadam. In short, it is when our predecessors in highway construction have bequeathed us something of real value that we should be alert to utilize to the very best advantage, former expenditures in base course construction.

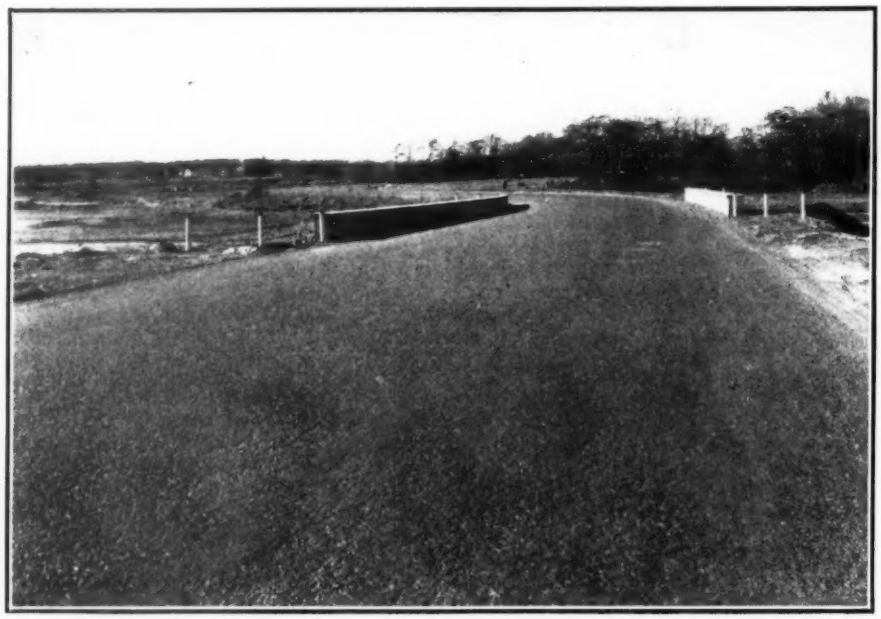
To my way of thinking and from actual observation there are altogether too many so-called road builders entrusted to build this, as well as other types, who, either from a lack of knowledge of the details making for good construction, or else, from a standpoint of discounting in advance the merit of the pavement, fail to get real value received for the expenditures made.

Relative Importance of Bituminous Macadam.—As to the relative importance of bituminous macadam, it may be of interest to note that an article on "The Trend of Highway Design," May, 1927, Roads and Streets (the matter compiled by engineers of the Office of Public Roads) shows that bituminous macadam increased its popularity over previous years and it is presumed here that since the time of this article the popularity of this type has not waned. Of all Federal Aid road mileage completed by types to June 30th, 1926, bituminous macadam comprised 5.6 per cent and cement concrete pavements 20.3 per cent of the total mileage, but of the one year ending June 30th, 1926, bituminous macadam was 7.4 per cent of the mileage done while concrete was 24 per cent. This demonstrates that this type is still "in the picture," and if we are to do it, let's do it as well as we are able to do it.

The writer wishes to emphasize here that in his opinion bituminous macadam is much more difficult to construct in a thoroughly satisfactory manner than many of the other types of pavement in present use. Cement concrete pavements of today are constructed under most meticulous specifications for materials and methods and under careful field control and with the mechanical equipment at hand for uniform and speedy results and the exactitude required to have the surface conform by templates and finishing machines to the required even surface there is much less of the individual workman's skill re-

View of Baxter Boulevard, Portland, Me., Showing Asphaltic Macadam Finished August, 1927 Start of Landscape Treatment Shown on Side. Slope to Sidewalk Will Be Planted with Flowering Shrubs

quired. With the recognized mixed types of asphaltic construction we have the laboratory control and the advantage of highly standardized gradings of aggregates, analyses of bitumen and many other helpful matters, but with bituminous macadam it is not practicable to control the construction by such clearly defined methods and, written specifications to the contrary, officials in charge of bituminous penetration construction many times find themselves somewhat at the mercy of the contractor for this kind of construction and his ability to value details, which add considerably to the merits of this type of construction.



View Showing 1928 Asphalt Macadam Construction at Hanson's Creek, Baxter Boulevard. A 48 Ft. Width of Newly Paved Surface. Note Coarse Texture of Finished Surface in Foreground, Also Slight Overlapping of Seal Application in Foreground and Small "Fat" Spots in Right Middle. These Are Slight Defects to Guard Against in Construction of This Kind

The Importance of Rolling.—For instance it is not general practice to "true" a surface of macadam pavement with a straight edge (although this has been tried in some sections of the country with varying success) and we must admit that surface irregularities of any consequence are incipient causes of failures in a pavement. Nor is it very practical to say, in a quantitative manner, in advance, the extent to which stone shall be rolled before penetration application, after penetration, and finally after seal coat. The two points mentioned may appear relatively unimportant to some, but to the writer, who has had considerable experience in this class of construction the matter of intelligent and adequate rolling is all important, and many times the lack of thorough compaction will spell disaster to the road under traffic. The quality of stone in the construction of bituminous pavement, being variable within accepted limits of wear tests, it remains to the engineer or inspector in charge to get as much compaction and interlocking of particles of the stone course before penetration as possible without serious crushing of the stone particles, with consequent choking of the voids and prevention of thorough penetration of bituminous material throughout the thickness of the wearing course.

Of course, stone acceptable for the wearing course should stand a reasonable amount of rolling, but many times we run into stone that varies on the work and if it is a case of withholding a measure of rolling, so as to insure thorough penetration of bituminous material, this should be done by all means. It is particularly after penetration that the writer would insist on most thorough rolling. It is extremely important that the operator roll and roll and then roll some more, and to do so, if possible, in the warmest part of the day. Let it be said that it is not always easy to get the present day road roller operator into the spirit of rolling such as described.

You will think that this is too much space to give to this one detail of this comment, but the writer has observed this point of construction to be a rather critical one in the success of bituminous macadam. At the point of surface irregularities it is quite obvious to most road builders that bumps and hollows cause trouble either by weaknesses arising out of impact of traffic or from freezing and thawing stresses to say nothing of the discomfort of riding. And since generally speaking we do not grade by template the coarse stone that is presently being used in this type of pavement, you can readily appreciate the care involved in getting a true and even road shape by the use of mechanical stone spreaders and some hand grading.

It facilitates greatly the matter of surface grading, as well as adding something very valuable to the construction, to have the base course of stone graded as nearly as practicable, parallel and uniformly below the finished surface and to have the base course finally compacted and tightened by the method of void filling by dry rolling (if possible) into the base all the screenings or sand (screenings preferred under dry weather conditions) that can be put in and yet leave a "toothy" surface to this course.

Thickness of Wearing Course.—As to the thickness of the "wearing" course of macadam, 3 in. seems to be the popular thickness and with the present practice of using stone passing a 2½ in. ring it would not seem sensible to have less than this thickness. While 5 in. is a popular thickness for base course, under exceptional conditions for foundations it would seem sensible to cut down on this thickness of base course, in accordance with conditions as you may find them; but one thing must be kept in mind and that is that any macadam surface requires considerable depth of base course, or foundations material to distribute the surface pressure over a good area of subgrade.

Application of Bituminous Material.—To the writer there is always a very intimate relation between depth of penetration course, size of stone used, and the amount of bituminous material applied. We are very cautious to control the amount of bitumen by weight when handling the fine and coarse types of asphaltic concrete. And, although we rely a great deal for stability on the interlocking particles of stone in bituminous macadam, we should have a quantity of bituminous material sufficient to cover the surfaces of the particles. If it is determined by practice and investigation that a certain specified amount of bituminous material will accomplish this for a given depth and grading of stone, we should adhere to this quantity for the conditions determined and not depart from this by way of being careless of the depth of stone. During 1927 and 1928 construction, the writer has had excellent results using approximately 1.75 gal, for the first application and 0.75 gal. for seal coat where the nominal depth of course was 3 in. and the stone trap rock of commerical 2 in. size (passing 2½ in. and retained on 1½ in). These rates conform to good practice and are closely watched by the writer during construction.

In connection with the use of bituminous material, probably the outstanding offender is the one who uses a surplus of material with resultant "fat" spots. The writer has frequently observed men lacking experience in the use of bituminous materials, who naturally believe that a good "dose" of the "black stuff" is good insurance and work accordingly. This getting out of hand should not occur on important

road work as this item is pretty carefully controlled, but you can observe it in small repair work or very small projects where experience is not the guiding hand.

Grading and Application of Keystone. —There is one detail of construction of bituminous macadam which has occurred to the writer to deserve perhaps a little more mention that it usually gets. This is the matter of grading and application of the so-called "keystone" following the first application of bituminous material. Up to a short time ago, at least, there appeared to be two "schools" in New England when it came to this detail of construction. One prominent state was using the same sized stone for "keystone" and final seal coat topping, this being a trap product passing ⅝ in. and retained on ¼ in. (so-called "pea stone"). The other school used for "keystone" a product passing 1 in. and retained on ⅝ in. and for seal coat "pea stone" size passing ⅝ in. and retained on ¼ in. Both states apparently secure good results, although in the former case the mosaic of the larger road stones is much more clearly defined, while in the case of the use of the ¾ in. stone after penetration followed by the use of the "pea stone" for seal, the mosaic appearance is obscured and the surface is for some time after construction somewhat rougher in texture. The writer has had very satisfactory results with the use of the two sizes of stone in connection with the bituminous applications and it would appear to be more in keeping with a desire to get density and stability by using more graded stone materials. Moreover, there is apt to be dust troubles when the smaller size stone is applied to first applications. Clear stone is much to be preferred even if this product does seem a little "coarse" and has an apparent tendency to break the initial bond of stones in the wearing course.

The writer has found it well worth the trouble and small expense involved to take care to broom the chips about after rolling with a view to filling surface voids uniformly, and after removal of surplus chips to roll lightly again. This rolling seems to give a better appearance to the road surface when finally finished with the seal coat application.

In conclusion, much of the foregoing comment will seem elemental to those who have made a close study of the essentials to good construction of bituminous macadam construction, but the purpose of this article will be served if it will help to impress the less experienced with the importance of watching details in the progress of this type of road construction. The matter contained herein has been discussed without much thought to taking the several points of construction as they are met in the order of work.

Engineers in Public Life

A recent canvas by the American Engineering Council disclosed a number of engineers holding responsible positions in the political life of the nation. The study covers a canvas of governors of all states and members of the senate and house of representatives.

Beside the engineer in the chief executive's chair, President Herbert Hoover, those listed are divided into three classes. First, those who are or were at the time of their election to public office, professional engineers both by training and experience. The second group comprises those who have been engaged in work which is essentially engineering and which requires the engineering mode of thinking and method of approach. The third group is of those who received their basic training and education in engineering—those who received a bachelor of sicence degree in an engineering school, but have subsequently taken up other fields of activity.

Engineer Governors. — The governors who are professional engineers are: Clayton D. Buck, of Delaware; George H. Dern, of Utah; F. C. Emerson, of Wyoming; Morgan F. Larson, of New Jersey, and George A. Parks, of Alaska.

Governor John H. Trumbull of Connecticut has received no engineering degree, but has been engaged in the manufacture of electrical machinery, having been president of the Trumbull Electric & Manufacturing Co., chairman of the board of the Colonial Air Transport Co., director of the Hartford Steam Boiler Inspection Co., and similar enterprises.

Governor Bibbs Graves of Alabama, although a lawyer, received his first degree as a bachelor of civil engineering, University of Alabama.

Governor O. M. Gardner of North Carolina, was a student at the State College of Agriculture and Engineering and received a B. S. degree from the University of North Carolina.

Governor Harry S. Leslie of Indiana received the degree of B. S. from University of Purdue.

Two recent and well-known ex-governors are professional engineers: James G. Scrugham of Nevada and James Hartness of Vermont, past president of American Engineering Council.

From this survey there would seem to be a decidedly increasing tendency of the public to trust men of engineering training with public office. Iu 1920 there were but two governors of states who could be placed in one of the three classes above. In 1910 there were likewise only two.

Engineer Senators.—In the U. S. senate of the 70th congress there were five men with engineering training and experience. These were: Vice-President Charles Dawes, Senator R. B. Howell of Nebraska, Senator H. W. Keyes of New Hampshire, Senator Tasker L. Oddie of Nevada, and Senator Millard E. Tydings of Maryland.

A decided increase in the number of men who have engineering training and experience is shown. In 1920 the senate had but two men who could be placed in these classifications, and in 1910 there were three.

Engineer Congressmen. — The house of representatives in 1910 contained three professional engineers and three members with engineering experience, also three with B. S. degrees. The house of representatives in 1920 contained two men with engineering experience and thirteen who had received B. S. degrees. The house of representatives of the 70th congress, 1929, contained a total of 21 members with engineering training or experience.

The five members of the house of representatives, 70th congress, who may be classed as professional engineers, are: L. W. Douglass of Arizona, H. L. Englebright of California, S. S. Arentz of Nevada, Ernest R. Ackerman of New Jersey, and J. T. Deal of Virginia. The following have had some engineering experience: Paul J. Moore of New Jersey, Wm. L. Carss of Minnesota, John McSweeney of Ohio, Franklin Menges of Pennsylvania, and Louis Monast of Rhode Island. The members who have had training in some engineering institution and in most cases have received B. S. degrees from an engineering college are: R. A. Green of Florida, L. J. Dickinson of Iowa, W. B. Gregory of Kentucky, David Kincheloo of Kentucky, W. P. Martin of Louisiana, W. P. Colo of Maryland, Jess Bushby of Mississippi, F. M. Hale of New Hampshire, A. J. Griffin of New York, George C. Peery of Virginia and F. T. England of West Virginia.

Training City Managers

The report of the Committee on Curricula of the International City Managers' Association, according to the Toledo City Journal, indicates that there are now five universities offering courses designed especially for the training of city managers, namely, Michigan, Syracuse, California, Stanford, and the Agricultural and Mechanical College of Texas. There are several others offering courses which might be considered suitable for the training of city managers, but which have never been organized as such. These include Chicago, Cincinnati, Harvard, Illinois, Kansas, Ohio, North Carolina, Wisconsin, and the National Institute of Public Administration. A number of others such as Northwestern University, Western Reserve and Toledo University, which the committee might well have considered in its report, while giving a great deal of municipal government make no special claim to training city managers.

Water Supply Costs

Unit Costs of Collecting and Distributing Systems

SOME interesting figures indicating the expenditures required for supplying water to large population centers such as the New York region are given in the report "Physical Conditions and Public Service" of the Metropolitan New York region of the Committee on Regional Plan of New York and Its Environs. The report was prepared by Harold M. Lewis, Theodore T. McCrosky and Raymond A. O'Hara of the Engineering Staff, Regional Plan, Hastings H. Hart of the Russell Sage Foundation and Henry C. Wright, Hospital Consultant. The matter following relating to unit water supply costs is taken from advance page proofs of the report.

Collecting Systems.—The Catskill System of the City of New York was constructed between 1907 and 1926, and includes Ashokan, Schoharie, Kensico, Hillview and Silver Lake Reservoirs. Its total cost was about $188,000,000 and it provides 600 million gallons daily. This gives a unit cost of approximately $313,000 per million gallons daily.

The cost of the Ridgewood System on Long Island, which was started in 1850, was, up to 1906, about $16,900,000 including reservoirs.[1] This furnishes 127 million gallons daily and the unit cost amounts to $133,000 per million gallons daily.

The Joint Board authorized by the Massachusetts Legislature to report on the water supply of the Boston Metropolitan District estimated, in 1922, that a new system to supply 202 million gallons daily would cost $59,946,540 or about $300,000 per million gallons daily.

Hazen, Whipple & Fuller, in their report to the Board of Conservation and Development of the State of New Jersey, in 1922,[2] estimated that new supplies would cost from $173,000[3] to $417,000 per million gallons daily. The North Jersey District Water Supply Commission estimated, in 1926, that the unit cost of the 100 million gallons daily of the Wanaque project would be $204,000 and that the complete development of the Chimney Rock project to furnish 750 million gallons daily would be $229,000.[4]

The Board of Water Supply of New York City estimated that proposed new supplies in Putnam, Dutchess, Columbia and Rensselaer Counties, totaling 422 million gallons daily, would cost $575,000 per million gallons daily, while an initial development of 204 million gallons daily from the same sources would have a unit cost of $736,000.[5] The New York City project for developing new sources in the watersheds of the Delaware River and Rondout Creek has been estimated to have a unit cost of $505,000 for a yield of 510 to 540 million gallons daily.[6]

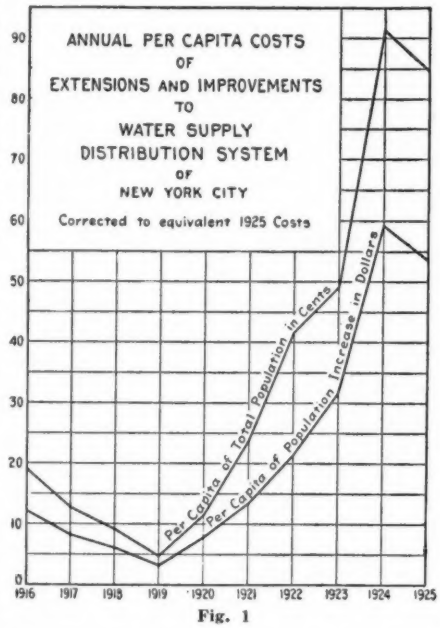


Fig. 1

It is probable that additional supplies for that part of the Region east of the Hudson River will cost from 50 per cent to 100 per cent more per million gallons daily than did the Catskill supply, or $450,000 to $600,000.

It can be assumed that the territory west of the Hudson River can be supplied more economically due to its readier access to sources of supply, or at costs per million gallons daily of approximately $250,000 to $450,000.

The per capita cost of developing a water supply (exclusive of distribution system) now varies from $30 to $60. An average figure would be about $50 per capita.

The consumption per capita in New York City in 1925 was about 140 gal. per day. An average figure for estimating future demands in the Region would be about 150 gal. per capita per day.

Distribution Systems.—The distribution system for the Ridgewood supply in Brooklyn cost, up to 1906, about $13,197,000. By 1926, New York City was spending about $8,000,000 per year on its distribution system. This was high as it included some deferred costs due to lack of funds during the war period. Such expenditures were considerably less than normal for about ten years after the opening of the Catskill System as the main aqueduct, which passes under the city, took the place of many new trunk distribution lines that would otherwise have been necessary. In March, 1927, plans for an auxiliary deep-level aqueduct for Catskill water estimated to cost $67,249,000 were approved by the New York City authorities. This will run from Hillview Reservoir in Yonkers across the Bronx, under the East River, and across Queens and Brooklyn, and will be 17 ft. in diameter for the greater part of its length. It was estimated that it would take about seven years to complete it.

The normal figure for extensions to the distribution system would be in the neighborhood of $4,000,000 per year. The maintenance charges upon the distribution system are approximately $1,250,000 per year. The average annual increase in water supply requirements in New York City from 1915 to 1925 was about 32 million gallons per day.

A factor for use in estimating future costs of extensions and improvements to the distribution system was obtained by taking the Department of Water Supply records for disbursements on the distribution system from 1916 to 1925, correcting these for changes in the cost index and reducing them to costs per capita. The results, shown in Fig. 1, give a curve which may be applied to future population.

The cost per capita, reduced to 1925 money values, has increased steadily from 1919, when it was 5 ct., to 1924, when the figure was about 91 ct., and in 1925 it dropped to 85 ct. The cause of this rise is explained above. As such expenditures are primarily for the use of the additional population, a curve has also been added for per capita expenditure on the basis of the annual population increase. This is seen to have varied from three to $59 and to have been about $53 in 1925.

Training Schools for New York State Municipal Employees.—A comprehensive program for the training of all groups of municipal officials and employees was adopted at a recent meeting of the Advisory Committee of the Conference of Mayors and Other Municipal Officials of the State of New York, according to the City Record, Boston. Ten years will be required for putting into effect the complete schedule, which calls for the establishment of training facilities for health, fire, charities and financial officials, civil service employees, water bureau superintendents, purchasing agents, city and village clerks, park officials and assessors. The conference has plans already under way for the training schools for fire department and charities department employees similar to those now being organized for police training, and the training of health officers is being taken care of by the State Health Department.

[1] Long Island Sources—Report by Board of Water Supply, 1912, Table 20, page 300.
[2] Report on Water Resources of the State and Their Development, January 28, 1922, page 63.
[3] This was based on a complete development of the proposed Long Hill System to provide 750 million gallons daily. The earlier steps in this system would call for much higher unit costs.
[4] 1926 Report, page 87.
[5] Computed from figures given in Report on New Sources of Water Supply, by the Chief Engineer, Board of Water Supply, September 13, 1926, page 6 and appendix of same, page 11.
[6] Computed from figures given in Report No. 36829, Chief Engineer, Board of Estimate and Apportionment, October 6, 1927, page 1.

The Identification and the Control of Algae

How to Identify Various Species and Control Them

By L. B. MANGUN

Chemist in Charge, Department of Water, Light and Power, Kansas City, Kan.

CONTROL of algae is, of course, the all-important objective, and the average water works man, usually very practical and very busy too, is primarily interested only in what contributes directly to that end. If, as in the case of one class of microscopic plant life, bacteria, there were some of the algae which caused disease if swallowed by humans, among many others which were harmless, then he would have had the same reason to be concerned about the identification of the harmful ones that he has had for differentiating Bact. coli. And if that were true there would undoubtedly have been some well-defined standards set up for his guidance with respect to them. But, as is doubtless understood by every one, algae in themselves are believed to have no sanitary significance. Rather, their presence in a water supply is usually thought of as objectionable for aesthetic reasons, because they impart color and cloudiness to the water. All forms of algae are obnoxious from the standpoint of appearance, but further than this, most of them cause the water to have a disagreeable taste and odor, and this fact does have an indirect sanitary significance. The public, not knowing the cause of the taste odor and ignorant of its harmlessness, will always imagine the worst, and in an effort to avoid fancied dangers many people will resort to the use of other supplies which may be available, such as wells and springs, which may indeed be unsafe bacteriologically.

Identification of Assistance.—Although identification of algae is not absolutely essential to control, it is nevertheless often of considerable assistance, just as complete knowledge about any process is more desirable than ignorance on the part of the person in charge of it. This information about the algae species with which one is dealing is valuable for record purposes and comparative study. It makes possible an understanding of their genesis, their life history, and perhaps a forecast concerning the probable future course and final results of their development. Incidentally, where the operator has the time and inclination he will find it an exceedingly fascinating study. The simplicity of the most essential laboratory manipulations in the process of identifying at least some of the more common forms is such that almost anyone, regardless of previous training, may do enough to become interested, if one has a little equipment with which to do the work. This need not be extensive, but a good compound microscope is essential. If a microscope is already at hand, the little other necessary apparatus is relatively simple and inexpensive.

Quantitative Estimation of Plankton.—Before taking up a discussion of identification of algae it would be well to give attention to the quantitative estimation of plankton, because it is probably of even more practical importance for control purposes than the determination of the identity of the organisms. By plankton is meant all microscopic, or near microscopic, aquatic life, other than bacteria, and excepting plants which are attached to the shore or basin walls. Many forms of tiny plants and animals suspended in or floating upon the surface of the water are collectively known as plankton. If the operator is to keep an open reservoir situation well in hand it will be of great assistance to him to keep a watch on the number of these plankton organisms present. Whenever he observes a sudden tendency for them to increase it will serve as a warning to him to apply treatment before their multiplication reaches the nuisance stage and be the cause of complaint on the part of consumers. If an initial increase in numbers is checked by treatment at once there will also be less of the objectionable after-effects due to the presence of large numbers of dead organisms in the water.

For the purpose of enumeration, in addition to the microscope, a counting cell, and ocular and stage micrometers are necessary. A Sedgwick-Rafter filter is sometimes a valuable assistance, though not often necessary for control purposes in settling basins and distribution reservoirs. This apparatus may be purchased from any of the laboratory supply houses. The counting cell is filled by means of a pipette with water from the sample as taken, or in case the organisms are few, with a concentrated sample from the Sedgwick-Rafter filter. After counting the organisms in a dozen or more squares and determining the average, the appropriate factors are used to find the number per cubic centimeter.

Standard Units.—It is sometimes more meaningful to state the quantity of the organisms in "standard units," which is a measurement in terms of volume rather than a mere count of numbers, because a large number of small organisms, such as the Protococcus forms, would affect the appearance of the water far less than a much smaller number of a large species, like Volvox. The area of the smallest square shown by the ocular micrometer is 400 square microns, which is equal to one standard unit. One Volvox per cubic centimeter would be equivalent to about 490 standard units, while 25,000 of some of the Protococcus species would be required to give the same number of standard units. The estimation in terms of standard units is preferable when the name of the organism is unknown, but if the organism is identified and its name given, then number alone has a more definite meaning. However, if there is a mixture of organisms the use of the standard unit is most desirable, and it is obligatory in making any definite quantitative statement concerning debris—broken-down amorphous masses from the disintegrated bodies of dead organisms.

Before the observer will have finished with the counting, if he is endowed with only the average amount of curiosity which characterizes the human species, he will have become interested in knowing something more about the tiny creatures with which he is dealing. He will want to see them better, and, as the low power of the microscope has probably been used for the counting, he will not be long in reaching for the 4 m. m. objective to get a more enlarged view. Next the question involuntarily comes to him, "What is it?" He may not be a botanist or a zoologist, but he feels much the same as he does when visiting the zoo or the circus, where he wants to see the names of the strange animals placarded on the cages, and he experiences a sense of irritation and dissatisfaction if the names are not there. He also would like to know from what country they come and he would be interested in any bits of information about their habits and manner of living. Now, there is probably as much incentive to satisfy that natural curiosity concerning the names of the algae as there is because it will enable him to say whether or not the organism will impart a taste to the water, what that taste will be like, and how much of a dose of blue vitriol will be required to kill it. This brings us to the subject of identification.

Identification of Algae.—If the water works operator has never studied botany or zoology at all, or extensively enough to have obtained some knowledge about the lowest forms of life, it would be very desirable for him to get an elementary treatise on biology from the

library. In the event that he has had an unpleasant and perhaps unsuccessful encounter with algae in his water supply, and especially after he has seen some of them under the microscope, he will find that, having made that sort of an approach to the subject, the book will be of the most absorbing interest to him. He will be amazed at the wonders he finds in this, to him, new world which he has discovered.

It is not intended to intimate, however that our amateur student of biology must master the details of structure and the intricacies of classification—species, genera, orders, etc.—before he can hope to identify any of the organisms found in plankton. He should procure a book containing descriptions and colored plates of the species most commonly met, such as Whipple's Microscopy of Drinking Water or the more complete Ward and Whipple's Fresh-water Biology, both published by John Wiley & Sons, New York. Though he may not be able to use the keys contained in these books at all systematically, even the most haphazard search in them will often reveal unmistakably the identity of the species, or at least the genus, he has met, unless it should perchance be an uncommon one, which rarely happens. As a matter of actual fact it is usually the genera and not the species one hears about. For example, the presence of Anabaena is reported in a certain reservoir. New, there are several kinds of Anabaena, but for practical purposes, the difference between them is not worth considering. The identical species one has under the microscope may not be shown in either of the books referred to above, but its resemblance to the one pictured will be such that one will know it to be a species of Anabaena. He will find, after locating it in this manner, that it belongs to the blue-greens, that it will impart a grassy or moldy odor to the water, and that a concentration of 0.1 p. p. m. of blue vitriol will be required to destroy it. Thus, while there are more than 1200 known species of blue-green algae, the number of genera are much smaller, and the most common among them are illustrated in these books. Whipple's book contains excellent colored plates showing nineteen species of the Cyanophyceae, or blue-greens, forty-eight of the Chlorophyceae, or greens, and fifty-one of the Diatoms. Then there are representatives of the microscopic aquatic animals, principally Protozoa. The Protozoa are the most important class of the non-algae plankton, of which forty-three species are illustrated.

What Algae Are.—It would perhaps be desirable for the orientation of beginners to explain briefly what algae are, and, since the authors referred to do not do so, to say a few words concerning the place they occupy in the world of living things. The term Algae is often used very loosely, sometimes almost synonymously with the word plankton, which includes both plants and animals. Algae are plants, and constitute one of the three groups of plants called Thallophytes, the name given to those having no root, true stem, leaves, flowers, or seeds. The other two Thallophyte groups are bacteria and fungi, which differ from algae in that they have no chlorophyll. The algae are characterized by the presence of chlorophyll, but the green color of chlorophyll is masked in many of them by yellow, brown, red, or blue coloring substances. The fresh-water algae are divided into three classes, the diatoms, which are yellowish-brown, the blue-greens, and the greens. The last group are algae in the strictest sense of the term, though botanically algae include the diatoms and the blue-greens also. The brown and red orders of the algae are mostly marine, and are therefore not encountered in our water supplies. Diatoms are one-celled, usually free-swimming, and are the most numerous order of the algae, more than 12,000 species being known. The greens and blue-greens are either simple unicellular or filamentous, the latter free-floating or attached. About 1,200 species of the blue-greens and 5,000 greens have been identified. In addition to the algae the plankton plant-life includes a few of the non-chlorophyll Thallophytes, yeasts and molds, which belong to the fungi.

The representatives of the animal kingdom found among the micro-organisms inhabiting fresh water are the Protozoa, which are unicellular organisms, the lowest form of animal life. Then there are other minute animals which are multicellular, the Rotifera, or wheel-animalcules, the Crustacea, or water insects, and the Bryozoa and Sponges, both of which are animal groups, though they are fixed and plant-like in appearance.

This animal life feeds upon the vegetable portion of the plankton, Hence. if the algae are not allowed to flourish these organisms are held in check through deprivation of their food supply. That is fortunate, because the algae are more susceptible of the poisoning action of the treating agencies than are most of the animal groups.

Attempts have been made to control algae in uncovered reservoirs by stocking them with fish which feed upon the algae, upon the assumption that fish are a less objectionable form of life in a water supply than algae. This plan has difficulties. If the basin is overstocked there will not be sufficient food and some of the fish may die. Dead fish are even less desirable in a finished water than live ones. On the other hand, if the fish are too few they will not consume all of the algae, especially at times when it is growing most rapidly, and it is very difficult under these conditions to treat the water chemically to destroy the excess algae without killing the fish wholesale.

Methods of Control.—The most common method of control has been by the application of algaecides to the water. Until quite recently blue vitriol was used almost exclusively. It gave very satisfactory results in large impounding reservoirs, and it is still the favorite treatment in them. Under those conditions dosages low enough to be harmless to fish life are usually effective. But blue vitriol never gave correspondingly satisfactory results in settling basins and storage reservoirs, and during the past two or three years chlorine has been rapidly displacing it. The continuous change of water in these reservoirs makes frequent treatment necessary. Where there is a constant flow of water, as in settling basins, continuous treatment of the influent is desirable, and that should probably be considered a misuse of blue vitriol because of the possible cumulative effect of copper. But the generally turbid character of the surface supplies of Kansas protects the water as received from carrying excessive plankton growths, such as would give trouble from tastes or clogging of filters. Algae, in common with all chlorophyll producing plants, require sunlight, therefore they do not multiply in water not clear enough to allow the sun's rays to penetrate beneath the surface. In the event that there is sufficient retention of the settled water in the finishing basins, there would be an increase of algae in them proportional to the clarity of the water and the length of the period. But retention is probably not of sufficient duration in many cases to give serious trouble, so that, while prechlorination, i. e., chlorination of the raw water, is being employed in some instances and has given admirable results with respect to its algaecidal action, these have been incidental to the primary objective of this chlorine treatment, which has been to reduce the bacterial load upon the filters. Where clear water is constantly moving through an open basin, soon to be delivered to the filters and thence into the underground distribution system, there is slight opportunity for plankton growth. Therefore, the free-floating forms do not become abundant. But the filamentous types which cling to the weirs and walls do grow very well under those conditions, and the growth is most luxuriant where the movement of the water is most rapid. Prechlorination has proved to be decidedly effective in keeping down these clinging forms, thereby making possible the maintenance of clean basin walls without the necessity of frequent removal by mechanical means, such as scraping, or the lowering of the water and spraying the walls with blue vitriol solution to kill them.

Prechlorination.—A maximum chlorine dosage of about 1 p. p. m. in summer and 0.25 p. p. m. in winter has been sufficient to produce the above results at the Kansas City purification plant. Chlorine has been used as an algaecide

for such a short time that probably no one has yet determined with exactness the minimum dosages required to destroy the different species. Whipple's work, published fifteen years ago, gives data of this kind with respect to blue vitriol only which were the results of Moore and Kellerman's experiments a decade earlier. At Kansas City the chlorine dosage in the settling basins has been regulated with respect to its germicidal action only, but chlorine has been used for two years as an algaecide in the open storage reservoir which is a part of the City's distribution system.

A further result of prechlorination has been the elimination of Bryozoa from the filters, those strange animals so plant-like in appearance, related to the coral of the sea. These Byrozoa would formerly attain a length of several inches in the Kansas City filters, where they presented a matted appearance on the walls and a shaggy, manelike effect as they hung downward from the troughs when the filter was drained. They could be washed loose by a stream of water from a garden hose and they were periodically removed in that way. But they disappeared soon after chlorination was begun and that operation is no longer necessary.

The conditions of algae growth and control in uncovered storage reservoirs differ radically from those obtaining in settling basins. There is no continuous flow of water through the typical storage reservoir, but rather, an alternate inflow and outflow, oftentimes of such relatively small proportions as to cause an approach to a condition of stagnation. Here is such abundant opportunity for cumulative growth of plankton life that, given the extremely favorable conditions of light and temperature which are often ideally provided during the summer months, frequently the rapidity of their multiplication is best described by the word explosive. Within a day's time a relatively clear body of water may take on a very clouded appearance, due to the sudden production of countless millions of algae, usually all of one species. In the spring these will probably be diatoms, in summer, the greens, in late summer, the blue-greens, and in the fall, diatoms again, but none of these classes are strickly confined to those seasonal divisions.

Recent experiments have demonstrated the superiority of chlorine over blue vitriol for algae control in storage reservoirs, but whatever agent is used it is obvious that the method of application must be entirely different from that in settling basins. In the former it is necessary to treat the entire contents of the reservoir at one time. This may be done from a boat or, if the arrangement of the reservoir is such that the incoming water can be caused to mix thoroughly with the algae-laden contents of the reservoir, the chemical may be more conveniently applied to the influent, at a time when the direction of flow is inward, which is usually at night. As in the case of settling basins, a dosage of 1 p. p. m. has been effective in the Argentine reservoir at Kansas City, during the warm portion of the year. No treatment at all is usually necessary from October to May. In storage reservoirs the treatment is best applied intermittently, when required, and not continuously, and it is used only as often as experience with local conditions and the rate of algae growth indicate to be necessary.

The control may generally be considered as satisfactory if the number of organisms is kept down to one or two hundred per cubic centimeter. Trouble from most species may be expected if the number exceeds 1,000, and serious trouble if over 10,000. With respect to production of tastes and odors, however, quite as much depends upon the species as upon numbers, since the quality and intensity of the tastes produced varies among them, and some affect only the appearance of the water. Thirteen thousand Synedra per cubic centimeter in the Argentine reservoir in one instance elicited no complaint from consumers on account of taste.

Acknowledgment.—The foregoing is an abstract of a paper presented at the recent meeting of the Kansas Water Works Association.

Destroying Slums by Excess Condemnation.—The Regional Plan of New York and Its Environs, according to the City Record, Boston, calls attention to the fact that under the New York statutes, although not explicitly stated, excess condemnation may nevertheless be used as an indirect means of improving housing and destroying slum areas. A tract consisting of several streets and the land between them can be chosen; the land between the streets condemned; the streets closed, widened or changed in location; and the central portion of the land turned into a public park or utilized for some other public purposes. Excess land around the boundaries, not needed by the public, can be sold under proper restrictions aimed to insure an appropriate building development. By proper management, this can be done at a good profit. The public use must, however, be the primary purpose of the proceedings.

How Philadelphia Helps Relieve Traffic Congestion.—The city of Philadelphia has a plan whereby parking fields are maintained, outside the downtown districts, where motorists may park their cars for 25 cents, which also includes carfare on the Philadelphia Rapid Transit lines to and from the downtown districts. The system gives considerable relief for traffic congestion.

Street Cleaning at Toronto, Ont.

Methods and Costs of Work in 1928

THE general duties performed by the Department of Street Cleaning of Toronto, Ont., embodies the cleaning of public streets, lanes and thoroughfares, the collection and disposal of ashes and household waste material, the cleaning of catchbasins, the oiling of unimproved roadways and the removal of snow from the downtown section and main car lines. The following information relating to this street cleaning and road oiling is taken from the 1928 report of George W. Dies, Street Commissioner.

Patrol System.—The patrol system is used in the downtown business area and main business thoroughfares; that is, each patrolman has a defined area to patrol, which may be covered from one to eight times a day. According to its requirements, each patrolman is provided with a paper picking bag, push cart, broom, scraper and shovel. He covers his beat on the first round each morning with the paper bag, and removes all loose paper which may be on the boulevards, walks or roadway. He then commences his rounds, removing all street dirt which is deposited in the pushcart. As the tubs are filled, they are left at designated points, to be later picked up by a truck.

The remaining sections are under the squad system, that is, the men working in pairs, one on each side of the roadway, followed by a pick-up vehicle. This system is carried out in residential and outlying sections.

The various streets receive a cleaning once or twice weekly, according to their requirements and the funds available.

The congestion of motor traffic increases the hazard of the patrolman's work, as well as retarding the efficiency of the men. Parked motor cars and vehicles prevent the proper cleaning of the channels and the removal of litter.

The enormous amount of building which has been projected during the past year has also added its quota to the difficulties which attend this important service. These are, however, contingent perplexities which must of necessity be met by all municipal administrations and can to a great measure be coped with by adjustment of hours of work.

Each patrolman maintains on an average three miles of street, covering approximately 40,000 sq. yd., an area far too large to be properly covered by one patrolman. Street dirt should be removed as near as possible to the time of its origin, in order that vehicular traffic may not grind it into a fine dust

to be scattered by the prevailing winds to the general discomfort and annoyance of the public.

There is perhaps nothing so offensive to pedestrians than to be met by a dust-laden gust of wind. This condition is impossible to control at certain times during the fall of the year, when there are high winds and street flushing is impossible, due to the dangerous and slippery condition that would be created.

Unit Cost of Hand-broom Sweeping of Improved Roadways for 1928

Total cost (foremen, labor, cartage, supplies)	$277,866.00
Area of improved street mileage (square yards)	7,606,991
Cost of maintenance per 1,000 sq. yd. per season	$36.53
Amount of sweepings collected (cu. yd.)	105,602
Cost per cubic yard (sweeping, collecting and removing)	$2.63
Cubic yards removed per 1,000 sq. yd. per season	13.9
Number of patrolman at $28.80 per week	190
Average area maintained per patrolman (square yards)	40,037
Average number of times swept per season	90
Cost of sweeping per 1,000 sq. yd. (sweeping, collecting and removing)	$0.406

Catch Basin Cleaning.—Catch basin cleaning is carried out systematically in each Division. The general work is usually commenced immediately after the spring cleaning of the streets. During the winter season they are given such attention as may be required, in order to keep them free from ice and obstructions.

The supervision of the work is under the direction of the district foremen. In certain outlying sections, the culvert cleaning squad, which consists of two culvert men followed by a pick-up vehicle, may operate through two foremen's districts. In the downtown and business sections, the culvert man is provided with a vehicle in order that the "cleanings" may be removed immediately from the channel.

All catch-basins are thoroughly cleaned in the spring, which is usually sufficient until the fall. On main thoroughfares, subways and troublesome locations, constant attention is given throughout the season.

Many householders are of the opinion that the gutters are provided on roadways for the convenience of placing grass cuttings and lawn rakings in. This practice, in the event of heavy rain, is the most common source for blocked gratings and culverts, the material being conveyed to the gratings by the flow of water, often completely blocking the openings.

The distribution of notice cards directing householders' attention to the fact that it is a contravention of the by-law to place grass cuttings or lawn rakings loosely upon the streets, has resulted in a marked improvement in this regard. It is, however, a problem which requires the constant attention of the inspectors throughout the summer months.

Summary of Catch Basins Cleaning, 1928

Expenditure (wages, cartage and supplies)	$18,353.09
Number of cubic yards removed	12,260
Number of basins cleaned	50,621
Cost per cubic yard (cleaning and removing)	$1.49
Cost per basin per season	0.36

Flushing.—The department had in operation last season, two electric and one gasoline flusher. The electric flushers are operated under air pressure, while the gasoline flusher is operated by a centrifugal pump.

The electric flushers are confined to night flushing in the downtown section. The streets receive a flushing each alternate night. The trucks are operated together, as by this method the best results are obtained, owing to the fact that it takes a few minutes for the dirt to become saturated, so that the second flusher may readily wash it into the gutter. On this account, a light rain just before or during flushing, aids considerably in obtaining real cleanliness, and is taken advantage of by operating the flushers as single units.

The gasoline flusher was engaged upon special flushing, due to the extensive excavation work and building operations carried out during the past summer. The contractors were required to remove any material that fell from trucks when leaving the excavation or on the route to the disposal point. Owing to the extent of several of these excavations and the continuous travel of the dump trucks hauling the earth over the same route, it was necessary to keep this flusher operating on these streets.

Street Flushing, 1919-1928

Year	Street Mileage Flushed	Quantity of Area Flushed (1,000 Sq. Yd.)	Quantity of Water Used (1,000 Gal.)	Cost per Mile	Cost per 1,000 Sq. Yd.
1919	1,670	33,827	8,546	$3.44	$0.1696
1920	3,169	61,400	15,435	3.05	0.1576
1921	3,834	77,869	20,591	3.29	0.1618
1922	7,156	161,416	35,100	3.03	0.1345
1923	3,865	90,326	22,267	3.56	0.1620
1924	3,332	83 358	18,355	3.54	0.1420
1925	1,702	39,318	10,830	3.65	0.1580
1926	1,615	37,680	8,950	3.25	0.1390
1927	1,294	30,405	7,173	3.24	0.1380
1928	2,002	46,110	9,563	3.18	0.1380

Road Oiling.—During the past year 750 applications of oil were made on 304 streets and 23 lanes. Several of these received as many as six applications, while others received only one. This was due to the nature of the roadway and amount of traffic passing over it. A sandy or soft road bed will soon absorb the oil and the constant disturbance by the vehicular traffic turns up the fine dust, making several applications necessary, while on a hard surfaced or macadam roadway, one application will last several months.

The oil is applied by motor truck, which is equipped with a square steel tank with a capacity of 1,170 gal. It is applied cold by means of a 2½-in. perforated horizontal pipe, 8 in. from the ground, and at the rear of the tank. The amount of oil used is based upon the condition of the roadway, while the flow of oil is controlled by a valve, operated by a conductor on the rear platform.

The oil is purchased in tank-car loads, which have a capacity of 5,000 to 8,000 gal. These tank cars are unloaded into storage tanks by a centrifugal pump, operated by a gasoline engine, which is capable of unloading a car of oil in two hours.

There are four oil storage tanks, with a total capacity of 120,000 gal. From these tanks the motor truck is loaded by gravity, utilizing the tank nearest the district in which it is working. The first load each morning is taken from the storage tank at the Don destructor, which adjoins the garage where the truck is housed.

The necessity of an oil storage tank in north Toronto is clearly demonstrated by the fact that 70 per cent of the amount of oil used, or 183,557 gal., was applied on north Toronto streets during last season.

Four years ago, only 39 per cent of the oil purchased was applied in this district, covering 64 streets. This number has now increased to 138 streets requiring oiling. The nearest storage tank is located at the Don Destructor, which on the average necessitates a 5-mile haul. This overhaul was in a measure overcome last season by spotting tank cars of oil on the Merton Street siding, from which point the oil truck was filled by the pumping outfit. The oil truck was able to distribute a tank car of oil a day in this manner, it also eliminated a long uphill haul and covered 25 per cent more actual work. This practice was not without difficulties, and additional expense. In the event of rain, the work was discontinued, and a day or so must elapse in order that the roadway may dry out to a certain extent. This incurred demurrage charges as well as blocking the siding. There also was the expense of two men attached to the pumping outfit, while unloading the tank car. It is therefore obvious that a storage tank in this vicinity would effect a great saving, as well as increase the efficiency of the truck.

Road Oiling 1916-1928

Year	Mileage	Area Oiled (1,000 Sq. Yd.)	Gals. Used (1,000 Gal.)	Cost per Mile	Cost per 1,000 Sq. Yd.
1916	181.6	2,863	280	$125.39	$7.59
1917	180.9	2,761	244	149.28	9.78
1918	108.2	1,743	172	203.84	12.65
1919	228.	2,943	354	120.66	9.34
1920	201.6	3,353	253	232.13	19.49
1921	173.8	2,150	253	130.27	10.54
1922	244.2	3,147	361	149.28	10.11
1923	188.7	2,342	338	170.20	13.82
1924	164.	1,886	295	170.34	14.84
1925	142.6	1,606	264	178.32	15.83
1926	136.9	1,613	244	171.81	14.65
1927	135.7	1,527	267	178.39	15.83
1928	139.1	1,578	294	153.29	13.51

A Common But Fallacious Doctrine

By HALBERT P. GILLETTE

"YOU can not, in reality, prove anything by mathematics," according to Dr. Charles Lane Poor, professor of celestial mechanics at Columbia University, who has been combatting the Einstein theory of relativity for ten years. Startlingly novel as Prof. Poor's statement may sound to some people, it is quite an ancient doctrine, and none the less false because of its antiquity and the high standing of many of its proponents.

The doctrine amounts to this: Given two premises from which a logical inference is drawn, and it follows that the inference not only contains no new truth but that the drawing of the inference does not serve to establish the truth of either of the premises.

For example:

(1) All gold is malleable.

(2) This specimen is gold.

(3) Hence this specimen is malleable.

If the major and minor (2) premises are true, then the deduced conclusion (3) is necessarily true, but it is said to contain no new truth and that it does not establish the truth of either of the premises, Mill's Logic discusses this doctrine at great length, and he concludes that it is sound; but he fails to see that there is more to this matter than the mere mechanical combination of two premises to produce conclusion.

Using algebraic symbols we may write:

(1) x=a.

(2) a=b.

(3) Hence x=b.

And it is evident that the deduced equation (3) does not prove the truth of either (1) or (2), unless (and here lies the point) we put (3) to some test to determine whether it is a true equation. As a matter of fact Einstein did put his deduced equations to just such a test when he deduced the revolution of Mercury's perihelion and showed it to be in accord with actual measurements. His deduced formulas were again put to the test when he predicted the amount that a ray of light would be deflected by the sun, and the prediction was triumphantly verified.

So while it sounds quite plausible to say that you never get out of equations more than you originally put into them, it is really metaphysical sophistry; for what you truly get out of a deduced physical formula is a mathematical relation that you proceed to test by an appeal to facts. If it agrees (within the experimental or observational error) with the facts, the probability of the truth of the formula may be so great as to amount to certainty. And the greater the number of such agreements the greater the probability of the truth of the deduced formula if applied within the quantitative range that the original premises covered. Moreover, this probability increases not merely in proportion to the number of such cases, but in proportion to the product of their probability ratios. Thus if the probability of truth is 10 to 1 in a given case, and 100 to 1 in another case, and 50 to 1 in a third case, to each of which the formula is successfully applied, then the entire probability in its favor is $10\times100\times50=50{,}000$ to 1. Now it frequently happens that the probability ratios are much greater than those above given for illustration, so that practical certainty of the truth of a formula may often be attained by a single test of it, and a few such tests may raise its probability of its being true "a billion to one shot" or higher.

Among most scientists there is a curious lack of knowledge of the use of the laws of probability in testing the truth of theories. Were it otherwise, so many theories would not have remained unaccepted for decades, generations and even centuries. Couple this ignorance of the use of the laws of probabilities with a false doctrine such as Prof. Poor believes, and you begin to understand why the discoveries of so many scientists have met the same reception that Einstein's great discovery met for 15 years, and even now meets from so distinguished a person as Prof. Poor.

Lest it be supposed that the brief quotation at the head of this article does not fully represent Prof. Poor's position, the entire paragraph from which it was taken (as it appeared in the New York Herald-Tribune) will be given:

"Mathematical processes merely constitute a sort of specialized shorthand; they furnish simplified methods for carrying on elaborate and complicated arguments from assumed or stated premises. A conclusion is derived from certain definite premises, and such conclusion must inevitably involve and depend upon such premises. There is a mathematical law of conservation of knowledge, and you can never get out of any mathematical equations or formulas anything more than you put into them in the first place. You cannot, in reality, prove anything by mathematics."

I have indicated that this doctrine is false in that it fails to include what inevitably occurs in all rational research, namely, a testing of a deduced inference from an hypothesis (or premise) by an appeal to facts. And we have seen that Einstein put his theory to just such tests and that the measured results have agreed with his deduced results. All of which Prof. Poor ignores. Now let us consider a different sort of sophism in this doctrine that "you can never get out of formulas more than you put into them in the first place."

We venture to say that few students of geometry would ever embrace such a doctrine were they to follow the dictates of their own common sense. Take, for example, the deduced formula relating to the sides of a right-angled triangle, namely, that the square on the hypothenuse equals the sum of the squares on the other two sides. The deduction of this theorem might be called the greater "pons asinorum," because no geometrical ass can cross this bridge.

This theorem or formula is deduced by a line of mathematical reasoning that runs straight back to a few definitions and axioms; so apparently all that was put into the deduction was those few definitions and axioms. According to the doctrine under consideration, it was all hidden there when you read the first few and simple pages of your geometry.

If all that is in the "pons asinorum" is in those initial pages of geometry, why doesn't it disclose itself after a little inspection? Why must students struggle for weeks to get to a point where they can even understand what some Greek geometrician discovered more than 20 centuries ago?

When the average young man finds it none too easy to understand some of the pages of geometry, and still harder to remember them, to say nothing of originating such deductions himself, such a young man is not likely to swallow this doctrine without gulping rather hard.

It seems to me that the doctrine that all of geometry lies concealed in or embraced by the axioms and definitions is indefensible. The axioms lay down principles by which a thinking man may discover the properties of geometrical figures. Those properties were just as much concealed from view before the day of Euclid and his immediate predecessors in geometrical research as most of the properties of atoms and molecules were concealed from chemists before Dalton made that initial grand discovery that atoms unite in mathematical proportions as to weight.

It happens that anyone equipped with a pencil and paper, and a few drafting instruments, has at his disposal a geometrical research laboratory. True it is that few are taught to regard it as such a laboratory, and more is the pity; but by Euclid and by many another man of originality, this sort of paper and pencil laboratory was used to discover geometric properties of Nature. I say Nature, for I disagree entirely with those who think that men invented the triangle, the rectangle, the circle, the

ellipse, and all the other elementary geometrical forms. They existed in crystals, in the stems of plants and bones of animals, in the shapes of the sun and moon, in the paths of falling bodies, and in numberless other visible, natural things. But not till man began to study these natural forms did he begin to learn much about their properties. He is still learning, and perhaps never may cease learning, new geometrical properties. To say that these properties have always existed in Nature is true; but to say that they have always existed in the few simple premises (the axioms and definitions) of geometry is utterly false, if words are used to mean what common sense and custom has long prescribed that their meaning shall be.

What is true of geometry is true of all mathematics, in so far as the doctrine under discussion is concerned. Man often gets out of mathematics vastly more than he puts into his initial equations. Even where this seems not to be the case, careful analysis discloses that there has been an illusion. Take, for example, what Einstein put into his deduction that was not in any previous deduction, namely, his principle of relativity in its most general form. The rest of his premises consisted of established facts of physics and of mathematics. From these premises he deduced certain formulas. If results derived by their application to given cases agreed with the facts, such agreement indicated the probable truth of his principle of relativity; which truth, as above stated, was thus established. But this was not the sole test of its truth, for if he could deduce by aid of his principle of relativity a single formula that had been previously deduced from any established theory, then the probability of the truth of the principle of relativity became so great as to amount to practical certainty. He not only deduced one such formula, but many; the first two thus deduced being the formulas for relative length and relative time, previously deduced by Lorentz, who used established electric theories.

What Einstein put into his deductions was more than had previously existed in any similar deductions. Yet at first it seems as if he took out no more than he put in; but what he put in was a guess (even a wild guess) and what he took out was a certainty. The guess (his principle of relativity) became a certainty as a result of a mathematical deduction whose results were in accord not only with several established formulas but with two independent quantitive relations, one of which was already known but unexplained (Mercury's perihelion movement), the other of which was so novel as to be revolutionary in its significance (the gravitative bending of rays of light). If ever in all history a man took out of mathematics more than the mathematics itself contained, this is such an instance. Of course the very same sorts of amazing discoveries have been made by the aid of mathematics many times. Newton's discovery of the law of gravitation was precisely the same sort as Einstein's discovery that all energy gravitates. And in just the same way that Einstein's discovery has been belittled, so was Newton's.

Curiously enough German astronomers long argued that Newton had discovered nothing new, and that all he had found was another way of showing that Kepler's laws of orbital motion were correct. (See Herschel's Essays and Whewell's Philosophy of Discovery.) Apparently those German astronomers held very much the same doctrine as Prof. Poor holds, namely, that you can't get out of mathematics more than you put into it. But I doubt not that Prof. Poor would be among the last to agree with those German astronomers of two and a half centuries ago that Newton had discovered nothing that was not already known to Kepler; for even in the alleged cold world of science, much depends upon national and racial prejudices, to say nothing of the egotisms that make many of us loath to admit that we did not discover a thing that seems so obvious when once discovered.

The part that mathematics plays in research is that of an engine or tool, by the aid of which quantitative relations are deduced. Relations thus derived are put to the test by comparing them with facts, and if agreement is found a physical discovery is said to have been made.

The engine-like nature of mathematics is well seen in the planimeter, that truly remarkable integrating machine by means of which plotted areas may be measured. An irregular closed figure of unknown area lies before you, and a planimeter is in your hand. Does the planimeter contain that area in its mechanical head? Is the unknown area somehow concealed in this machine? The question sounds ridiculous, yet it is not a whit more so than the doctrine under consideration. Just as an unknown area does not lie concealed in a planimeter, so an unknown geometrical relation does not exist in the axioms and theorems by the aid of which that unknown relation can be discovered. Whether a formula is applied by the aid of a pencil and paper or by the aid of a machine, like the planimeter, the formula does not contain the desired answer to a question, but is merely a tool that, under certain conditions, may be used to secure the answer.

It is frequently contended that logic need not be taught as a distinct science, but that all its precepts and methods are readily acquirable during the study of other sciences. And mathematics is itself held up as an excellent illustration of a science that teaches logic. But when professed and skillful mathematicians have no better conception of its fundamental nature as a tool than to believe that the tool can contain the answer sought, and that nothing can, in reality, be proved by mathematics, it would seem needless to argue that there is crying need of the teaching of research logic as such, and not merely as an incidental part of other sciences.

John Fritz Medal Presented to Herbert Hoover

The John Fritz Gold Medal for 1929 was presented to Herbert Hoover at the Executive Mansion, Washington, Thursday, April 25, at a luncheon given by Mr. Hoover to present and past members of the Board of Awards, preceding medalists, and presidents and secretaries of the American Societies of Civil, Mining and Metallurgical, Mechanical and Electrical Engineers.

This medal is the highest honor bestowed by these four national engineering societies, having a membership of 60,000. It is awarded not oftener than annually for "notable scientific or industrial achievement, without restriction on account of nationality or sex." In accordance with custom, the award to Mr. Hoover was made tentatively and without announcement in October, 1927, and was formally confirmed and announced one year later.

At the presentation on the 25th, Dean Dexter S. Kimball, College of Engineering, Cornell University, chairman of the present Board of Award, presided and gave a brief history of the medal. He is a past-president of the American Society of Mechanical Engineers.

Dr. M. I. Pupin, a past-president of the American Institute of Electrical Engineers, and a member of the Board of Award, spoke briefly of the human elements of Mr. Hoover's lifework.

Dr. John R. Freeman, past-president of the American Society of Civil Engineers and the American Society of Mechanical Engineers, and a former member of the Board of Award, spoke of Mr. Hoover's work as an engineer.

Mr. J. V. W. Reynders, past president of the American Institute of Mining and Metallurgical Engineers, and chairman of the board which made the award to Mr. Hoover, presented the medal and quoted from the certificate which accompanied the medal the citation "To Herbert Hoover, Engineer, Scholar, Organizer of Relief to War-Stricken Peoples, Public Servant."

The ceremonies ended with a statement by Mr. Hoover.

Among the men to whom the medal has been awarded in preceding years are J. J. Carty, Elmer A. Sperry, Edward Dean Adams, John F. Stevens, Ambrose Swasey, Guglielmon Marconi (Italy), Eugene Schneider (France), Sir Robert A. Hadfield (England), Orville Wright, George W. Goethals, J. Waldo Smith, Elihu Thomson, Thomas A. Edison, Alexander Graham Bell.

The Overloading of Sanitary Sewers

Experiences in a New Jersey Town

By ALEXANDER BLAIR
Civil Engineer, Westfield, N. J.

THE cause of overloading of sewers has long been a subject of importance. In 1903 the American Society for Municipal Improvements had a discussion upon flooding, and at that time they attributed quite a large part of it to infiltration. In 1913 the American Society of Civil Engineers discussed the subject. At that time, it was shown that contributory flooding was due to infiltration. It was stated then (and Metcalf & Eddy have since confirmed the figures) that infiltration flow in sewer pipe of 30,000 gal. per mile is a maximum flow—a very heavy flow. Since that time a number of things have been tried to reduce flooding, but in order to minimize the flow the unknown sources contributing must be traced.

Leakage may be found through the walls of manholes or through the perforated slots in the tops of manholes or from pipe lines running through water courses, etc., but after finding and eliminating the sources mentioned, very heavy flooding may still be found. I have had experience with this in two towns, Summit and Westfield, N. J. In Summit about 5 years ago it was found that at certain seasons there was heavy flooding in the system. The entire sewers were gone over and every contributing cause found was remedied, but the flooding still continued.

Infiltration Not Main Cause.—At a later date in Westfield the same condition was found to exist. Only cast iron pipe with lead joints had been used for house connections since 1913, in order to reduce infiltration as well as for other reasons. Everything had been constructed absolutely tightly. All of the sewer laterals and mains since 1913 were laid with the best flexible joints known, and under rigid inspection. Strangely enough flood measurements by the writer in 1924 compared with flood flows recorded after investigation by Hazen & Whipple in Westfield in 1913 showed relatively the same high rate of flow as in 1913, the increase in normal and in flood flows being in almost exact proportion to the growth of the town. This proportion was maintained whether compared in terms of population per mile of sewer, or per house connection made, and since the construction work of the past ten years ensured tightly joined mains and connections it indicated that infiltration was not the cause of the major part of this trouble. Using the infiltration figures quoted, and they are heavy, (30,000 gal. per mile) would only account for 20 to 30 per cent of the maximum flood flows in storm periods, and the normal sewage flow would be only about 10 to 20 per cent of the maximum flood flows. Naturally, the question arose, where is the balance of 50 per cent to 70 per cent coming from?

Survey of Leader Connections.—A survey was made of leader connections, which showed that there were some old houses having leaders taking the roof drainage connected to the sewers; of course, there were a number of pipes running below the surface and in some cases it was hard to tell if those also were connected, but, assuming that they were all connected, that would only account for a very small percentage of the flow. From what source then could this excess come? It was suspected that a number of the builders were misusing the sewers as a drainage system. This was against the ordinance and I think it is so in most towns—but the builders thought that it was legitimate to make use of some existing means of drainage while constructing their houses and in many cases continued it after completion.

Misuse of Sewers by Builders.—In 1924 one violation was found in making the customary test on a sewer lateral just completed, where instead of making the usual internal hydraulic test to see what loss of water occurred when the pipe was plugged at the outlet, the inspector blocked up the outlet as usual, but left the sewer tight and dry, since there was a ground water level at that season well above the level of the sewer, by which an external test might be made. The inspector on returning was very much surprised to find the pipe filled with muddy water and traced it back to two building excavations. The matter went before the council who considered modifying the ordinance so that in future no sewer connection could be made until the building being constructed had a roof on it. A meeting was called, the builders came out in force and said they couldn't do without sewer connections when cellars were being dug as they would not have any means of draining the cellars. The council ultimately agreed that the true solution of the difficulty was the construction of storm sewers and that until they were built it would be difficult to enforce such an ordinance.

Some builders had been using patented traps, allowing a surprisingly large flow of water to pass. It was found by observation in some houses that these traps worked steadily for days after a storm. Investigation showed that after careful inspection of the house connection by the health inspector, and following his departure when the floor was ready to be concreted the builder would proceed to tap a hole in the side of the soil pipe and cover it over with stone or a piece of tin. In some cases a trap or small sump was left in the floor to which the sub drains were led and the floor then concreted concealing what had been done.

Ten Times Normal Flow.—With a population of about 12,000, the normal sewage flow was approximately 1,000,000 gal. daily. This was measured by weir at the sewage plant and verified by the water company's records of consumption. During periods of storm, after the ground had time to saturate, the flow would increase to 3,000,000 and 4,000,000 gal. daily. In extreme periods, occurring once a year, perhaps more often, when the ground water level was high and frequent and continued storms occurred, the flow has reached as high as 10,000,000 gal. per day, though this was only of brief duration. As has already been shown, the 10,000,000 gal. per day flow was difficult to account for. All manholes were inspected and found tight; and practically all had tight covers. These covers in the spring time usually had a cover of tar over them; very few of them got water in them in that way. There were no weak points in the system. It was demonstrated that the flows from brooks, water-courses, leaders, etc., could not contribute more than half a million gallons of that flow and that the houses that had roof leaders connected to the sewers would not account for any large portion of that flow.

Analyzing the Abnormal Flow.—Analyzing the flow of 10,000,000 gal. daily the respective contributions were estimated:

(1) From normal sewage flow about 1,000,000 gal.

(2) Based upon the figures of Metcalf & Eddy as stated above, about 2,000,000 gal. might be allowed for infiltration in pipes.

(3) From the roof leaders and traps in the cellars about 500,000 gal. more.

Assuming the discharge into sewer connections from cellar subdrains through patented traps and openings in house connections to be about 1,500,000 gal. more, there would still be a considerable flow left, so the cellar excava-

tions were the only reasonable remaining sources left and it was assumed that the balance of 5,000,000 gal., possibly more, must be due to this. At that time about 250 houses per year were being built and the open excavations connected with the sewer and of houses under construction would number from 75 to 100. The observed heavy flow from several cellar excavations tended to confirm these findings.

It is strongly urged that where similar conditions exist they should be followed up and it is suggested that municipal engineers and maintenance departments study their flows, tabulate them, and check up on their house construction and connections to see that there is no misuse of such connections. It is probable that this is, in many cases, the main source of heavy flows and this is urged as the strongest argument for having the engineering department or sewer maintenance force take over the work of inspection from the health authorities who are not at all familiar with these problems. It is also suggested that it would be of great value to the engineering profession as a whole in the matter of design if such studies, where made could be carefully tabulated and presented for publication later.

In good practice a maximum of 250 to 300 gal. per capita is allowed in designing most systems and any flow beyond these figures endangers treatment plants and causes the waste of large capital expenditure when additional plants and new intercepting drains and outfalls are thus necessitated.

Results of Flooding.—Flooding of sewage systems results, in the first place, in undue tension in pipe lines, the joints of which are not designed to resist such internal pressure, the weaker joints giving away, and, in some cases, sewage will flow up over the surface of the ground, out through the manholes or back into the cellars. This backing up of sewage into the cellars is a serious menace. The effect of flooding on the treatment plant is that the bacteria, most delicate organisms, which under normal flows do wonderful work in the digestion of sewage, cease to function satisfactorily, sewage is not digested, and is discharged in a raw state into the streams where it consumes the dissolved oxygen in the stream, thus kills the fish and allows mosquito breeding, as one of the preceding speakers mentioned. Attention of the speaker was drawn to this by a game warden who had stocked with fish a pond lying below a sewage outlet; sediment from sewage flowing through the treatment plant in time of flood conditions which was practically untreated, had so used up the dissolved oxygen in the pool that the fish were unable to exist, and mosquito larvae not only thrived on the sewage but no longer were eaten by the fish as is normally the case.

Acknowledgment.—The foregoing is an abstract of a paper presented at the recent convention of the New Jersey Sewage Works Association.

Action of Currents on Floating Material

In order to determine to what extent pollution of shores and beaches might have been caused by the refuse deposited at sea by New York City, the Chief Engineer of the Board of Estimate and Apportionment made an investigation during the summer of 1926 by releasing a total of 7,433 bottles with return post cards enclosed. The returns from these have been analyzed and the results submitted to the Board of Estimate and Apportionment. These bottles were released in three lots on July 1, July 7 and July 27, respectively. The first of these was placed in the water at the strength of the flood tide, the second at the strength of the ebb tide and the third at slack high water. The point of discharge in each case was about 20 miles southeast of Scotland Lightship at the dumping ground used for city garbage. Up to June 30, 1927, a total of 2,419 bottles had been recovered and were picked up at the following destinations:

Up to the latter part of August, 1928, there had been 2,444 bottles recovered, including some on the coasts of Cornwall, France and Portugal. None had been reported at points along the Atlantic Coast to the east or north of Long Island.

Destination	Number Recovered	Per Cent
Long Island	909	37.6
Lower New York Bay	55	2.3
Staten Island	1	....
New Jersey	550	22.7
Delaware	186	7.7
Maryland	97	4.0
Virginia	345	14.3
North Carolina	257	10.6
At sea	14	0.6
West coast of Ireland	5	0.2
	2,419	100.0

Mr. Arthur S. Tuttle, the Chief Engineer of the Board of Estimate and Apportionment, drew the following conclusions from this experiment:

"The results of the experiment appeared to indicate that the normal action of the currents on floating material in open water outside of New York Harbor is seaward rather than landward, and that sustained landward winds are necessary to bring about the movement of any floating material from an off-shore point 20 or more miles distant to the adjacent mainland. From the information presented . . . by the Commissioner of Street Cleaning it appeared that practically none of the garbage dumped at sea would float indefinitely, and considering the time interval required for the floating bottles to reach the mainland, that under other than exceptional conditions floating garbage, moving as a rule much more slowly, would become water-logged and sink before it could reach the shore in any appreciable quantity."

Cost of Horse Maintenance at Toronto, Ont.

The Department of Street Cleaning of Toronto, Ont., during 1928 had 383 horses in service. The care of the horses is under the direction of a veterinary surgeon, whose services are engaged on a per capita basis of $4 per horse per annum. His duties are to render the necessary veterinary services to sick horses, advise as to the proper feeding of the animals, and take the necessary sanitary precautions against disease. He also examines and certifies as to the soundness of all new purchases, and condemns animals unfit for further service.

The average life of a horse in the service of the department is 6½ years. It is therefore necessary to purchase from 50 to 60 animals each year to maintain the standard. During 1928, 50 horses were purchased at an average of $231.

A card record is maintained of each horse as to date and from whom purchased, price, color, markings, age, height and weight. The time lost by horse, due to illness or other causes, is also recorded, as well as the date of disposition, cause, and sale price.

Cost of Feeding.—The average daily rations per horse, based upon the consumption during the year, amounted to 13.2 lb. of oats, 33 lb. of hay, and 0.25 lb. of bran, while in addition 0.1 lb. of other feed was given, consisting principally of salt, vegetables, etc. Each horse was also bedded with 4.4 lb. of straw daily, while the specific rational allotment is 15 lb. of oats, and 25 lb. of hay per horse per day. This amount in many cases varied according to the temperament of the horse. On Sundays and holidays, or in the event of horses standing in the stable, only light feeding of oats is given.

The purchase of fodder supplies is an important item. Every care is exercised to ascertain that all feed is of Government standard and free from moisture, dust, or must. The importance of this cannot be too strongly stressed in order to guard against the danger of heaves, colic, distemper, and other common diseases.

The following table shows the cost per day per horse:

	Average amount per horse per day			Cost per horse per day
Oats	13.2	at $ 0.677	per bus.	$0.262
Hay	33.2	at 14.38	per ton	.237
Straw	4.4	at 10.30	per ton	.023
Bran	.24	at 35 18	per ton	.005
Salt	.04	at 22.50	per ton	.005
Daily average number horses				381.6
Total horse days				139,671
Cost per horse per day				$0.527

We are indebted to the 1928 report of George W. Dies, Street Commissioner of Toronto, Ont., for the above information.

A Proposed Traffic Plan

Method of Providing One Way Traffic for City Streets

SOME time ago Alvaro Pratt, a retired civil engineer, of Los Angeles, Calif., submitted to the Traffic Commission of Los Angeles a plan for eliminating traffic congestion on the streets of the city. A gyratory plan, similar in many respects to that proposed by Mr. Pratt, has been placed in operation in London, England, in all the chief congested areas, like Trafalgar Square, Piccadilly Circus, Hyde Park Corner and Blackfriars. In most cases the main streets were turned into "one-way" streets which called for gyration, and although it added slightly to the distance to be covered by traffic, the speeding-up is stated to have been great.

A journey along the Strand, which used to average 15 minutes during the rush hours, is now stated to be frequently done in three to four minutes. Waits of four or five minutes, which frequently occurred at Trafalgar Square or Piccadilly Circus, are now practically eliminated.

The plan as proposed for Los Angeles is described by Mr. Pratt as follows:

"Traffic congestion in Los Angeles, today, is due to the attempt of two bodies to occupy the same space at the same time. The resulting conflict and confusion cannot be remedied by literary pleas for polite road manners, wider streets, multiplication of traffic ordinances, increasing violation penalties, or doubling the traffic squad. An automatically operating, and mechanically correct plan must be provided.

"This plan should require of the auto driver a minimum of skill, experience, ability, and knowledge of the law. Such a plan will be radically different from that now in use. Some interests will be affected adversely, or will fear so, and demand 'no change.' Public officials, rusted in the old ruts, will resent new ideas. The public will require a considerable educational effort—probably a year or more.

"Absolute paralysis of traffic is only prevented, today, by the employment of alternating curents of traffic. When one goes, the other stops. Each current starts from a stand-still. The maximum effective forward motion is about 25 per cent of that of a continuous stream.

"Left hand turns around a single center button reduce this efficiency one-half, while the vehicle is turning. This reduces the effective forward motion at a one button intersection to 12 per cent of that of a continuous stream.

"Continuous stream traffic can only be secured by the elimination of the right angle crossing, and the substitution therefore of traffic stream blending in the central portion of the blocks, instead of crossing at the corners. Collisions, on one way streets, would be rare, and would consist almost entirely of real end impact. Responsibility for this should be put entirely on the car that strikes. At night there would be no adverse glare of head or spot lights—in fact the stronger the light the better for everyone on the street. Pedestrian traffic would be safer, on one way streets, as the danger would be only from one side.

"The speed of the stream between corners should be not less than eight miles per hour. No vehicle should be permitted which is incapable of being operated at that speed. Motorcycles, bicycles and horses should be prohibited. The motorcycle and bicycle, because neither their speed nor direction can be estimated by others, nor can they slow up without stopping. The use of horses on city pavements is cruelty to the animal, blockades the bulk of the other traffic, and distributes horse manure over the surface of the street.

"Fire apparatus, hospital ambulances and police vehicles might have the same rights against adverse traffic as at present. When joining with one way traffic, no tie up would be possible in front.

"Traffic stream blending between corners can only be done on one way streets.

"One way streets with continuous non-stop traffic streams, require rotary traffic within a definite district.

"Rotary traffic must proceed from right to left, as seen from the inside of the rotary district. The area of the district may be one or more blocks. The district could always handle smoothly all traffic that could be delivered by the adjacent streets.

"The plan includes the territory from Temple to Seventh and Hill to Main:

"North bound traffic—Main and Spring.

"West bound traffic—Temple, First, Second and Third.

"South bound traffic—Broadway and Hill.

"East bound traffic—Fourth, Fifth, Sixth and Seventh.

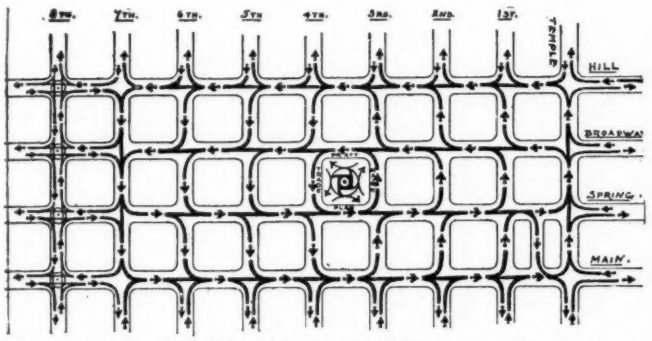


Diagram Showing How Motor Traffic Would Flow in One-Way Continuous Streams Through the Congested District of Los Angeles Under the Pratt Traffic Plan—North on Main and Spring Streets, South on Broadway and Hill, West on Temple, First, Second and Third Streets and East on Fourth, Fifth, Sixth and Seventh

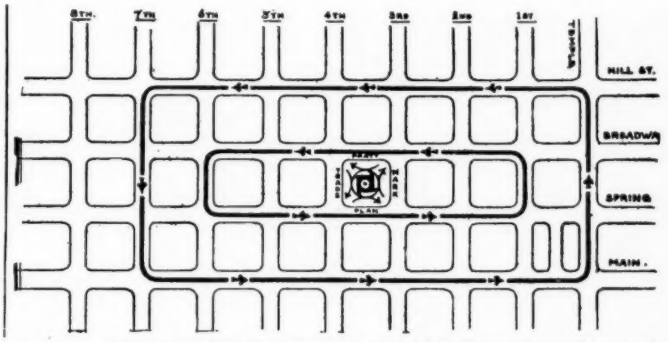


Diagram Showing Double Line Bus Routes Within Down Town Congested District of Los Angeles, as Provided in the Pratt Terminal Plan. Street Cars and Outside Motor Buses Would Stop at Terminals at the Outer Edge of the District and Their Passengers Would Be Taken Through the District as Indicated

"Tunnels and elevated ways on First from Fremont, and on Fourth from Figueroa, to Los Angeles St. will soon be necessary to carry through East and West bound motor traffic across Main, Spring, Broadway and Hill on separate grades.

"Street car traffic is possible within the rotary district, either as through service, or belt line loops. But a shuttle service from the suburb to the rotary district and return to suburb, would permit of accurate adjustment of number of cars to number of passengers; reduce by 50 per cent the "Lost Time" due to mechanical mishaps on through suburb to suburb lines, and eliminate the "Dead Time" due to traffic congestion for which congestion the street car itself is largely responsible.

"Full load terminals would reduce the car loading lost time by 90 per cent and substitute one stop for ten or more.

"Suburban traffic terminals, roofed and floored, on the edge of the "Outside Loop" would permit passengers to wait for, board or leave the street cars in comfort and safety.

"Street car and bus terminals should be located on private property fronting on the outer loop, with vehicular entrance from the next street over.

"Double belt line busses should then be provided by the street car and motor bus companies to carry their pas-

sengers without additional cost through the congested district, the busses moving with the other motor traffic around an outer loop consisting of Hill, Seventh, Main and Temple Sts., and an inner loop consisting of Broadway, Sixth, Spring and First Sts. These busses should have floor level with sidewalk, one door to enter, and one for exit, operating on the ordinary pavement with power to turn out for, or pass, each other, or other vehicles, and transfer passengers at reserved sidewalk, or street car terminal stations. No fares should be collected, cost of operation should be included in the street car fare from the suburb to the city; street car transfers being eliminated. Women, children and aged people could use the loop busses to cross intervening streets, when going in that direction. Pedestrians would presently get the rotary habit. Boarding or leaving a bus should not be more aggravating or dangerous than entering an elevator.

"The cost of construction of the plan would be probably 1 per cent, possibly 10 per cent, of the cost of either subways, or elevated railways. It would be superior to either, in the factors of flexibility of modification, cost of extension to new territory, effect on adjacent property, and stabilization of down town realty values. It would be more healthy than a subway, less offensive than an elevated, and could be abandoned at any time a superior substitute was found, with only a nominal loss of the capital invested.

"Parking: The parking or non-parking of automobiles does not effect the essentials of one-way streets, with continuous traffic stream flow. In fact, one-way traffic, of a single line, along the center of the street, would accommodate double the vehicles carried by any double line street today.

"Frontage interests will, in the final issue, determine parking, each section according to its views of its own interests—period, parallel, 90 deg., 45 deg., or none. Frontage owners today are obsessed with the idea that parking means good business, non-parking poor business, regardless of the fact that an average six-story building on a 50-ft. lot only affords parking at the curb for two cars. The shops and offices above contain from 100 to 200 clerks and professional people. Half of them have their own cars, say 100. Half of the prospective clients and customers are supposed to have cars, making a total of 200 cars to be parked. Parking capacity equals 1 per cent.

"There being, only 1 per cent enough room in the street, it is obvious the complete parking must be done on private property, if at all. Parking is mechanically feasible only on the ground floor. The shopping level might move bodily upstairs, and front on elevated or arcaded sidewalks, displacing the office tenants of the second floors, leaving the ground floor and present sidewalk areas for parking.

"Elevated side and cross walks would remove the pedestrian from the path of automobiles. The second floor would yield greater floor space, better light and be much cleaner than the present ground floor for the display of merchandise. But previous contracts, leases, and tenures, render it practically impossible for the downtown districts to avoid being abandoned by the automobile patron."

Water Supply and Sewerage in Environs of New York City

The recently issued report of the Committee on Regional Plan of New York and its environs, contains the following information on the provisions (as of Jan. 1, 1927) for water supply and sewerage in the principal communities in the environs of New York City.

Several of the communities obtain their water from two or more different sources. In New Jersey particularly there are many inter-connections between various sources of supply which have complicated the problem.

Of 330 communities in the environs which had public water supplies at the beginning of 1927, 291 were political subdivisions while the remaining 39 were nonpolitical units. There were several other small districts, mostly unincorporated, which were supplied to a certain extent by private water companies.

There were in all 150 sewage treatment plants in the environs serving the 205 communities with sewer systems. Adding the 17 plants within New York City makes a total of 167 plants in the Region, only 40 of which included some form of oxidizing treatment.

It is interesting to note the geographical distribution within the Region of the various sewerage and water supply facilities in the environs. Grouping these under the three states from parts of which the area is comprised, the following sewerage figures were obtained:

	New York	New Jersey	Connecticut
Number of communities listed	107	209	14
Those with sewer systems	60	138	7
Those with sewage treatment	39	101	6

All of the communities listed had some type of public water supply. Grouping them under a similar geographical distribution, the following figures for water supply were obtained:

	New York	New Jersey	Connecticut
Communities with municipally owned sources of water supply	47	72	3
Communities with privately owned sources of water supply	60	137	11

A summary of the sewerage and water supply figures for all of the environs is as follows:

Number of communities listed	330
Those with sewer systems	205
Those with sewage treatment	146
Those with municipally owned sources of water supply	122
Those with privately owned sources of water supply	208

Including in the water supply statistics the sources which have been developed within the limits of New York City, there was within the entire Region a total of 79 principal developed sources of surface water supplies. Of these, 45 or 57 per cent were municipally owned and 34 or 40 per cent were privately owned. There was also in the Region a total of 176 principal well stations where ground water supplies were developed. Of these, 102 or 58 per cent were in municipal ownership and 74 or 42 per cent were in private ownership.

Standing Committee Recommends Addition for Simplified Practice Recommendation on Paving Brick

Because of the increased demand for an eliminated size paving brick, the Permanent Committee for Simplified Practice Recommendation No. 1, Vitrified Paving Brick, has recommended to the industry that the wire cut lug brick (Dunn) 3x3½x8½ be reinstated as a standard type, according to the Division of Simplified Practice of the Bureau of Standards, U. S. Department of Commerce.

This size brick was eliminated from the recognized standard sizes on March 20, 1925, but the shipments for this size during the past three years has gradually increased until today it represents 14.5 per cent of the total based upon the survey of the industry in 1928. By the inclusion of the size into the simplification program, the Division of Simplified Practice stated that the degree of adherence to this recommendation is increased from 70.1 per cent to 84.6 per cent. There are now six standard, or recognized sizes of vitrified paving bricks.

In making this announcement the Division of Simplified Practice pointed out that the paving brick simplification was one of the initial projects developed by industry under the cooperation of the Department of Commerce. Much of the success attained by the program has been due to the support it has received from the Standing Committee and the National Paving Brick Manufacturers' Association.

The Division of Simplified Practice is the only organization engaged in waste elimination, through simplification and standardization, that subjects the effected programs to stipulated review, in order that they may be revised or modified in order to keep them abreast of current developments in the industry.

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The Cause of the Severe Winter Weather of 1928-29

Eleven years ago there occurred an exceedingly severe winter. History has just repeated itself, but doubtless some of the "frankly skeptical" astronomers will remain "frankly," although perhaps not so loudly, skeptical about the influence of sunspots on weather. It is no easy matter to change a scientist's mind once it has been well coagulated by a false doctrine.

There is a great sunspot cycle that reaches its maximum in number of spots about every 11.2 years, and it has been doing this with remarkable regularity ever since astronomers began counting sunspots about three centuries ago. On several occasions since those counts began (9 to be exact) the sunspot maximum did not occur within 18 months of the time that the so-called 11-year maximum was due. But on the remaining 20 times out of the total of 29 (counting from 1615 to 1928) the 11-year spot maximum came very nearly on time.

In the October, 1928, issue of "Municipal News and Water Works," an article gave the results of a long research by the editor as to the cause and periodicities of sunspots. In that article many sunspot cycles were listed, and each of the 8 planets was credited with a cycle; the date of the last maximum and the exact length of each cycle was given, so that anyone could check the results on a chart of the sunspot curve. A table was printed showing the dates of each of the 28 sunspot maxima from 1615 to 1917, and the dates of maximum sunspot influence assigned by the editor to Jupiter, Uranus and Neptune. It was shown that Jupiter, the largest of 8 planets, is responsible for the spot cycle of 11.21 years; when Jupiter's north magnetic pole points most nearly toward the sun, then Jupiter creates the most spots. Each of the other planets produces its maximum effect in a similar way; and because the magnetic poles of their upper magnetic fields are all revolving westward about their axes of rotation, the sunspot cycles that they cause are invariably shorter than their periods of orbital revolution. It was shown that 3 different times when a great sunspot maximum did not occur on or near a date assigned to Jupiter, it did occur on or near a date assigned either to Uranus or Neptune, those two planets evidently having more powerful electromagnetic effects upon the sun because their axes point much more directly toward the sun.

Since the next peak effect of Uranus is not due till 1951, and that of Neptune not till 1998, it was shown that Jupiter's 1928 sunspot peak would not be interfered with by either of those planets, and that the Jupiter peak would occur about Nov. 1, 1928.

Sunspots having anti-clockwise rotation are the main causes of our cyclonic storms. Nearly all storms are cyclonic, and in their whirling nature they are closely kin to the sunspots by which they are caused. Sunspots are known to be electromagnets (due unquestionably to the free electrons in the whirls), and the editor has reasoned, both by analogy and deductively, that our cyclones are electromagnets, electrically generated, electrically whirled and electrically propelled. He has been able to explain cyclonic phenomena far better by this theory than it has been previously explained by a combination of theories in which convection currents and centrifugal force are supposed to play the star roles.

Storm tracks (i. e., the paths of the centers of cyclonic storms) are often parabolic. This discovery was based on the electromagetic-whirl theory, and is explainable by no other theory. In fact it was not perceived by meteorologists because their theories did not guide them to look for it.

Storm tracks shift to higher latitudes during sunspot peaks, and thus produce weather anomolies. It is such anomolies that have puzzled many astronomers and have led some of them to express skepticism about the influence of sunspots on weather. One very cocksure astronomer has wittily said that predicting weather by the aid of sunspots is like trying to forecast which way an elephant will walk by studying the migrations of a tick on the elephant's ear. It may be replied that predicting weather far ahead without the aid of sunspots is as futile as to try to calculate planetary interactions unguided by a knowledge of gravitation.

The statistical literature showing quantitative relationships between sunspots and weather is already prodigious. Its very bulk apparently deters most astronomers from even glancing through it. The seeming inconsistencies and anomolies with which this literature abounds are even more forbidding. But in every other case where quantitative relationships have been discovered, diligent study has led to an untangling of the maze and a disclosure of the underlying simplicity of the phenomena.

The Tensile Strength of Water

When capillary attraction was first discovered it was thought that the answer had been found to the question, Why does sap rise? But capillarity was soon found to be inadequate. Later came the discovery of osmotic pressure, and again it seemed that the answer had been secured. Physicists have finally concluded that no forces known to act upon sap can account for a rise of more than about 150 ft., yet it rises more than double that height in the tallest trees.

Prof. H. H. Dixon, of the University of Dublin, has recently proved that water in capillary tubes has a tensile strength of several hundred pounds to the

square inch. Since this would suffice to lift a capillary column of water to the tip of the tallest tree, he has inferred that evaporation of the water in the leaves furnishes the lifting force. He becomes rather vague in trying to show how evaporating molecules exert a pull on the surface of water that they are leaving.

When a liquid evaporates it expands into gas, and gas would presumably exert a back pressure on the surface of the liquid, instead of a pull upon that surface.

The thought has occurred to us that when water in a capillary tube acquires tensile strength, it may be because some of its electrons are rotating in planes perpendicular to the axis of the tube. Each electron rotating in this manner would constitute an electric current, and since parallel electric currents attract one another, tensile strength would be produced in the column of water. The water column would resemble a magnet, and in fact would be a fluid magnet.

Such a magnet might then be forced up by the magnetic field of the earth, just as air in cyclonic air-whirls seems to be forced upward. And thus a more complete explanation of the phenomenon of the ascent of sap would be had.

Although there may seem to be no way in which the hydraulic engineer can utilize such a principle, let us not be too skeptical of our inability to apply it. It is evident that ways can be devised for releasing more electrons in water. Ultraviolet light, for example, effects release of electrons, and we are convinced that magnetic fields effect release of electrons. Picture, then, a pipe of small diameter into which highly electrified water is introduced at the base under the influence of a magnetic field that gives rotation to the electrons about the axis of the pipe. It is probable that the magnetic field of the earth would lift the water to a considerable height, and thus furnish the lifting energy free of charge.

What plants have learned to do on a small scale, engineers should be able to do on a large scale. The first step, however, consists in securing a full understanding of the reason why sap rises to the top of giant sequoias.

Hats Off to the Jack-Of-All Trades

Upon a time not so long ago, to be dubbed a jack-of-all-trades was to be labeled a worthless fellow. Perhaps the day is not far distant when that term will be regarded as one expressive of the highest approval. Ability to shift quickly from one occupation to another characterizes so many American workers as to have attracted the attention of some foreign visitors, but we do not recall reading that any of them saw in that versatility one of the main reasons for the economic progress that they envy.

Recently an English periodical published an account of the woeful experience of a shipyard worker who has been out of a job for several years, living on a small dole. The most instructive part of the tale was unintentionally written between the printed lines; for, although never explicitly stated, it was tacitly assumed throughout that the misery of this man would not end until ship construction again reached a degree of prosperity sufficient to give him back his lost job. While there are still some American workers who would thus wait years for their lost jobs to return, their number is relatively few, and steadily decreasing. A shipworker today, a farmer tomorrow, a truck driver the next day, and any old job thereafter, may not seem like good training for the man aiming at high wages, but none the less it has resulted in the highest average wages in the world.

Of course the prime reason for American high wages is great productivity per worker, and this is first of all due to science and invention; but neither science nor invention can operate effectively in the service of man unless there is freedom to apply the discoveries that they yield. In countries where workers regard themselves as irrevocably tied to their particular trades, it is not surprising to find it very difficult to introduce labor-saving devices. When a man feels that if he loses his job as a riveter in a shipyard and no other sort of job can be had, that man is sure to oppose any device that will enable men to drive more rivets; and if riveting were to be replaced by welding, well—! Great Britain is full of just that sort of men, with just that sort of attitude toward their jobs. The world war served to strengthen that attitude, and the dole was a political device that made the typical British worker more determined than ever to cling to the old tradition. No jack-of-all trades, he.

So long as most products were handmade, and required a deal of skill in their production, a shifting from one sort of trade to another was almost prohibitive. With the advent of machines in which the skill of the worker had been superseded by the "skill" of the mechanism, there suddenly came a change, or at least it would have come suddenly had not habits been of a stuff that changes slowly. The built-in-skill of the machine meant more freedom for the worker, freedom from years of apprenticeship at beggarly wages, and what is much more important, freedom to shift from one machine-tending job to another almost over night. This last-named freedom explains, in large measure, the absence of strong opposition to labor-saving devices in America.

British investigators come, and see, but do not comprehend. They go back with talk about "mass production," "high wages as a cause of great demand," and the like, but they fail to see that freedom is the one great factor that British industry lacks. There must first come a different outlook upon the job, the outlook begotten of knowledge that machinery can be used to free men from the tyranny of industrial caste, and there must come faith in a future where such freedom exists. This outlook and this faith are not to be created by any fiat, nor even by the most logical arguments. Outlook and faith are unfortunately matters of slow development; but the development can undoubtedly be hastened by judicious oft-repeated presentation of facts. America furnishes the facts without limit, but apparently they need to be interpreted to other nations; for even the men who come looking for them, leave without recognizing the most important fact of all, namely, industrial freedom.

H. P. Gillette

New Books

"Economics of Highway Bridge Types" by C. B. McCullough, Bridge Engineer, Oregon State Highway Commission; Member American Society of Civil Engineers; Member Oregon Bar; Special Lecturer in Structural Engineering, Oregon State College. First edition, 246 pages, 5¾ in. by 8½ in., hard cover, cloth binding; Gillette Publishing Co., Technical Publishers, 221 E. 20th St., Chicago, Ill., publishers. Price $5.00 net.

You have often heard the expression, "He could not see the forest because of the trees." The function of this book is to place the reader on a hill or in an airplane, as it were, to survey the forest. In other words, McCullough analyses the crossing problem from the broad viewpoint of selecting an economic type of bridge from amongst the many types that may be constructed.

This text has been compiled with a view to its utility not only to the practicing highway engineer, county engineer, city and consulting engineer, but to the undergraduate student in highway and civil engineering as well.

A prominent feature is the fact that the discussion has been prepared for the highway engineer in general rather than the highway bridge engineer.

The many cost and quantity curves and data sheets have been made sufficiently general in application to cover average practice and govern estimates of cost of structures designed according to general practice. The tables and curves should prove of great benefit to the engineer in the field engaged in highway location or relocation, to highway maintenance engineering organizations and to field parties, divisional organizations, municipal and county engineers and others engaged in the construction, location or design of highway bridges.

To the student in engineering this work should serve a two-fold purpose. First, as an outline of bridge economics and type selection in general it serves to direct his attention to a most important phase of bridge engineering and one to which scant time is given in most engineering curricula. Second, the many cost tables, curves and illustrations, covering in fact practically all of the commonly employed types in highway bridge construction, will serve to give him a rather thorough and comprehensive survey of the ordinary construction types, these affording him an opportunity to develop the necessary and much to be desired general perspective of the subject before taking up the complicated minutia of design and design methods.

"Prometheus, U. S. A." by Ernest Greenwood, author of Alladin, U. S. A., etc. First edition, 213 pages, 5½ in. by 8⅛ in., hard cover, cloth binding, illustrated, Harper & Bros., New York City, publishers. Price $2.50.

Beginning with the tales of fire as they are chronicled in myths, legends and the history of its uses down through the ages, Mr. Greenwood considers at some length the modern methods of uses of fuels and their relative merits in industry and home. He has collected a large amount of material on oil, gas and electric light and power and has been able to sketch the picture of the distribution of these agencies for their multitudes of present-day employments. "Automatic heat," he summarizes, "is the latest achievement of man in employing fire for his comfort and for industrial purposes."

Wood is referred to as the first fuel and one of the bulwarks on which this country was built. Facts are given on the supply of wood now available and what is being done to assure a continuing supply for future generations, pointing out that wood is no longer to be considered as a major fuel.

In summarizing the part that coal has played in the history of fuels, the author says,

". . . to coal goes the credit for building the very foundations of American industry and it will be a long, long time before it is entirely replaced by oil, water power or some synthetic fuel of the future.

"Without coal, our transportation system, the greatest in the world, would still be in its early stages of development. Coal was an important necessity in the smelting of iron so necessary for the rails and the equipment of our railroads. Coal was the only kind of fuel that was available in the early days; how far would our railroads have travelled if they had had to depend on wood? Coal was an absolute necessity to run the industries which eventually produced the machinery from which our water-power generating plants are built."

Following this, the gas industry is discussed, Mr. Greenwood citing instances of its early discovery and the difficulties that attended its commercial introduction in the last century in England and America. He includes a considerable amount of statistical information about the industry as it exists in this country today, pointing out that, as is the case with the light and power companies, gas companies necessarily are monopolies in the communities they serve. Other sections of this discussion deal with who owns the gas companies; coal as direct fuel and as raw material for making gas; coke and other by-products.

About automatic heat, as it is supplied by the modern oil burner or the modern gas heater, he says; in part: "There are many things of social significance which are accomplished by automatic heat aside from pushing into the background another piece of the ugly machinery of life. The growing desire for apartment house life is due, to a considerable extent, to the dread of the furnace in the basement. No one who has ever tried it will deny that the private house provides a far more satisfactory home life, particularly when there are children, than the apartment, which at best always has something of the atmosphere of a hotel and which almost always lacks the comfort of spaciousness to be found in even the most humble of dwellings."

"Prometheus" is easy to read. And it is a welcome addition to the library of popular books dealing with Industrial America.

"The Arithmetic of Sewage Treatment Works," by Karl Imhoff, Chief Engineer, Ruhoverband, Essen, Germany; Member American Society of Civil Engineers; translated from German by G. M. Fair, Asst. Prof. of Sanitary Engineering, Harvard University, Cambridge, Mass. 99 pages, 4½ in. by 7 in., flexible binding. John Wiley & Sons, New York City, publishers. Price, $2.00.

This little book is intended to assemble in small space the methods of computation commonly employed by sanitary engineers in the design of sewage treatment works. Statements of methods have been made brief. Exact mathematical calculations do not lead very far in the design of sewage treatment plants because the methods are based on practical experience.

"Financing of State Highways," compiled by Julia E. Johnson. First edition, 209 pages, 5 in. by 7½ in., cloth bound in hard cover. The H. W. Wilson Co., New York City, publishers. Price, 90c.

This book is based primarily upon the issue of bonds for highway purposes. It includes discussion of the sources of taxation to be drawn upon for financing and such practice, principles and breadth of discussion as abstracts permit. It is compiled from abstracts as shown in the bibliography and arranged for debating purposes.

"Building Estimators' Data Book," by Chas. F. Dingman, Architectural Engineer. First edition, 159 pages, 4 in. by 6½ in., flexible binding. McGraw-Hill Book Co., New York City, publishers. Price, $2.50.

This little volume is an addition to Mr. Dingman's other works and contains all of the estimating data that appeared in the other book, as well as more new and original material. The data is condensed and tabulated for ready reference, using the unit system of estimating.

A list of standard symbols for wiring plans is included.

"Masonry Dams," by William P. Creager, C. E., Member American Society of Civil Engineers. Second edition, 294 pages, 6 in. by 9 in., cloth bound, hard cover. John Wiley & Sons, New York City, publishers. Price $4.00.

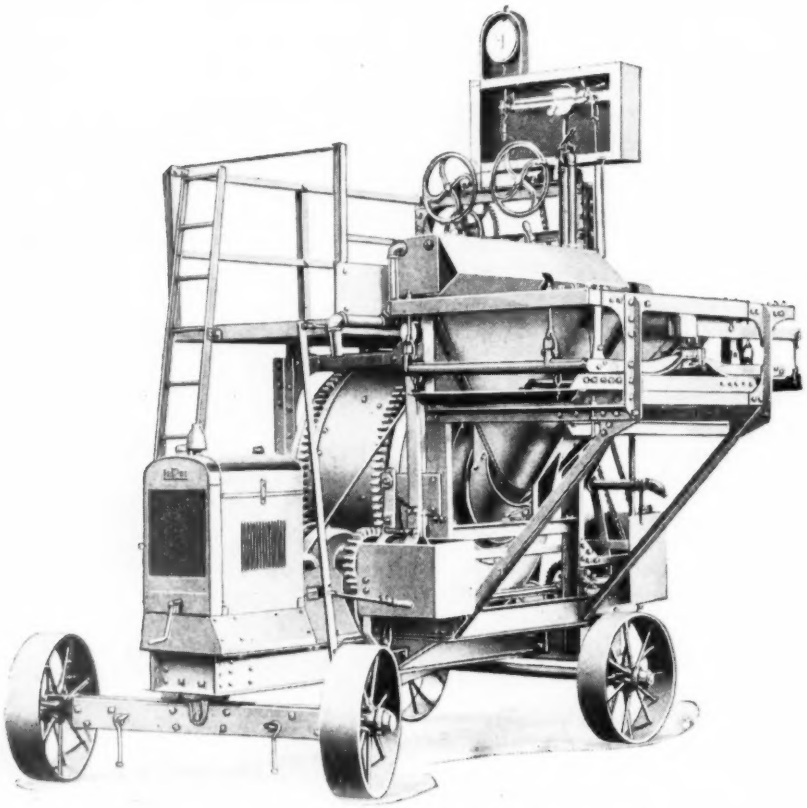
This is a review of the text of the first edition with obsolete matter removed, new material on newer developments included.

The book includes diagrams for quantities in solid gravity dams, backwater computations, fuller description of outlet control and flood gates and new chapters on arch dams and flood flows. Like sewage treatment engineering, this branch of civil engineering is based largely on practical experience and data learned from failures. The theory on which the design of masonry dams is based, the author acknowledges, is not exact, and, moreover, has not been verified by satisfactory experiments.

A New Mixer Attachment Weighs Water and Aggregate

A new mixer attachment called the Weigh Mix was recently developed by the Koehring Company of Milwaukee, Wis., manufacturers of pavers, mixers, power shovels and cranes.

This machine was brought out in response to a desire by contractors for a portable concrete manufacturing plant that could be charged with available equipment and which would be capable of accurate proportioning of materials by weight.



Weigh Mix Attachment for Standard Koehring Mixers

The Koehring Weigh Mix satisfies these requirements and fulfills the needs of the building contractor. It consists of a standard Koehring mixer, equipped with a weighing batch hopper and water tank mounted on an auxiliary frame carrying pipe lever scales.

All operations are controlled from the operating platform by one man. Materials are weighed into one hopper, thereby allowing for the use of as many aggregates as may be desired; gravel is normally weighed in first, followed by cement and sand; the water is weighed on the same beam and is carried in an open tank.

When the batch hopper door opens to allow for the charging of the mixer, the batchmeter is actuated and the hopper shaking device, operated by a cam on the main driving shaft, is started. The batch hopper discharges quickly, cleaning perfectly so that the scale will return to balance.

By mounting the weighing batch hopper on the mixer, head room is reduced as compared to the use of independent weighing or measuring devices. This allows a compact arrangement of controls for one-man operation. Due to the shape and position of the hopper, bulk cement and any number of differently graded aggregates can be weighed without additional equipment.

The batch hopper does not come in contact with the weighing mechanism while being shaken and therefore the accuracy of the weighing mechanism is not affected. The scale beam is boxed so that it can be taken off the plant for transportation, thereby insuring against damage.

The Koehring Weigh Mix is practical in design and is successful in operation. Although new, it has already attracted favorable attention from engineers and contractors who have been in touch with its operation.

Upon request the Koehring Company or any of its sales offices will send a special circular describing the Weigh Mix.

Cast Iron Pipe 18 Ft. Long Now Manufactured

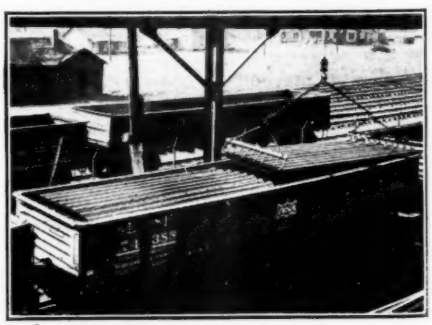
Eighteen foot lengths of deLavaud centrifugal cast iron pipe in all diameters 4 in. to 12 in. inclusive has just been announced by the U. S. Cast Iron Pipe & Foundry Co.

A battery of casting machines for the production of deLavaud pipe in 18-ft. lengths is now in operation at Birmingham, Ala. and the product will be found to measure up in every respect to the high standards established by deLavaud centrifugal pipe in 12-ft. lengths.

The advantages of 18-ft. pipe can be readily visualized when it is considered that as compared with 12-ft. lengths of pipe there is a reduction of 33⅓ per cent in the quantity of jointing materials required, in the labor of making the joints themselves and digging the bell holes. In the construction of plain end pipe lines for gas the use of 18-ft. lengths reduces the cost of couplings, or special connecting pieces, 33⅓ per cent and correspondingly reduces the labor involved in the installation of such couplings or special connecting pieces. Another feature is that with the longer lengths that are fewer number of joints which reduce the number of possible points of leakage in the finished line.

The equipment for handling the 18-ft. lengths of deLavaud centrifugal pipe need be no different from that used in handling 12-ft. lengths of cast iron pipe. For example, the standard weight of an 18-ft. length of 8-in. Class 150 deLavaud pipe, used for 150 pounds maximum working pressure, is 629 pounds. Compare this to the standard weight of a 12-ft. length of 8-in. Class C, sand cast pipe used for 130 pounds maximum working pressure which is 625 pounds; in other words, while the 18-ft. deLavaud pipe is 6 ft. longer than the 12-ft. Class C sand cast pipe, it allows an additional working pressure of 20 pounds and weighs only 4 pounds more.

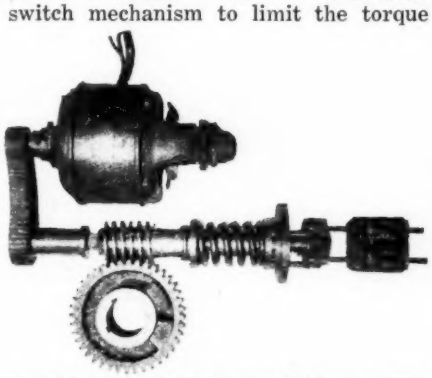
On account of the decreased weight per foot, as compared with the same diameters of sand cast pipe, the same number of men can be used to install 18-ft. lengths of deLavaud centrifugal pipe as are used for the installation of 12-ft. lengths of sand cast pipe.



Loading Car with 18-Ft. Cast Iron Pipe

Limitorque Improved

The Limitorque Corporation, New York City, have developed a mechanism for operating valves, doors, etc. It is a reversible motor driven reduction gear valve controller with a mechanical switch mechanism to limit the torque



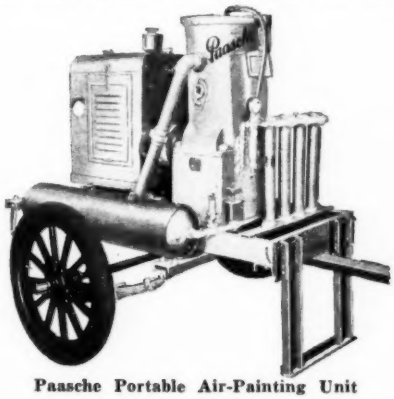
Complete View of Limitorque Mechanism With Case Removed

and travel of a slow speed shaft in both directions. Power may be electricity or compressed air, remotely controlled.

It operates through one pair of heavy grease lubricated worm gears, in an oil tight casing. The manufacturer states that Limitorque has a torque switch that stops the valve gate only when it is properly seated, regardless of travel. The valve gate may be closed to any desired degree of tightness. All seating and unseating strains are absorbed by a heavy compression spring. A positive unseating blow is administered at slow speed directly to the valve stem nut.

Air-Painting Trailer Unit Announced

The Paasche Airbrush Co., Chicago, Ill., announce the production of a new Paasche air-painting unit, a two-wheel trailer—new in design—that goes anywhere. It is equipped with a 64-ft. patented water and oil operator that



Paasche Portable Air-Painting Unit

removes water, oil, dirt and moisture from the airline, thus assisting in producing a better finish.

Paasche air-painting units, the manufactures claim, are the only portable units equipped with these patented water and oil separators.

New Pump Operated by Outboard Motor

A new type drainage pump, which is powered with a Johnson outboard motor and which is unique in that it is self-priming and will shut itself off when the water being pumped is stopped or gone, is now being manufactured by the Johnson Motor Company, Waukegan, Ill.

This pump consists of a long pump shaft with a light twin-cylinder outboard motor mounted on the top. This motor powers the impeller which is located at the bottom of the shaft. As the pump shaft sinks to the bottom of the water and the impeller is always submerged no air can be sucked while there is still water to be pumped. Thus delays in priming are eliminated. In addition starting difficulties are also eliminated as the water begins to flow immediately after the motor is started.

The automatic shut-off prevents the pump from burning out on the job. A

Johnson Portable Pump

workman can start it and can go away and forget it, for an ingenious safety device short circuits the magneto of the motor when water is not passing through the pump.

Some types of work to which this outfit is adopted includes pumping water from excavations, concrete forms, manholes and barges. It is also found highly useful in dredging work of all kinds.

It will pump 195 gal. of water per minute and 1,000 gal. for the approximate cost of one cent, according to the manufacturer. It can do in five minutes what would require an hour and a half for one man with a hand-operated pump and will do with a half gallon of gasoline what another unit may do on a quarter ton of coal, it is claimed. The outfit weighs 85 lb. and can be carried by a man.

Further information about this new pump may be secured from J. H. Sheldon, Johnson Motor Co., Waukegan, Ill.

A New Sewer Pipe Joint Material

The Standard Oil Company of Indiana announces an asphaltic product for making leak-proof sewer pipe joints. The product is known as No. 1 Korite (Brand 6775). No. 1 Korite is said to make a permanent, tight joint, and to prevent the leakage, infiltration and choking of pipes by roots. It is quickly prepared for use, and easily applied by an intelligent laborer.

It has been used on sewer pipe installations in various localities. Tests conducted by the engineers of the Clay Products Associations have proved that the No. 1 Korite is a satisfactory material for making a permanent, leak-proof joint.

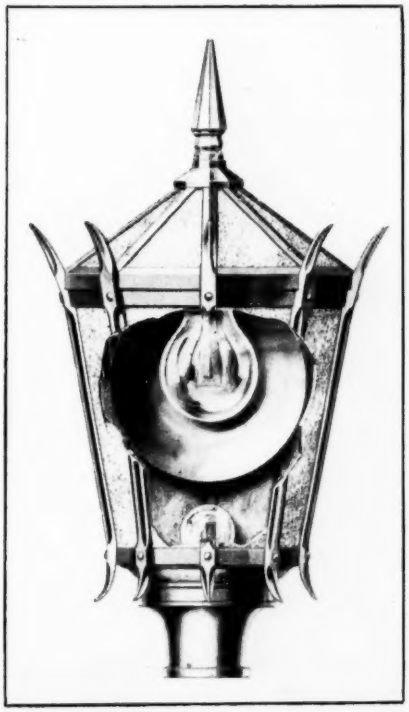
Copies of the No. 1 Korite folder, describing this product may be had by writing to C. C. Lakin, Manager of the Asphalt Department, Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois.

Ornamental Floodlights

The King Luminaire Company, 37 West Jackson Boulevard, Chicago, have added ornamental floodlights to their wide range of ornamental industrial lighting equipment.

King Luminaire floodlights are unique in that the floodlight reflector and lamp are enclosed in a King Luminaire ornamental lantern, eliminating the unsightly reflectors that have been used in the past, thus serving the dual purpose of a floodlighting lantern, plus the ordinary illuminating functions.

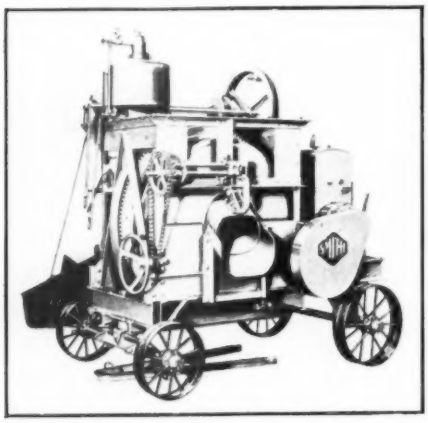
King Luminaire floodlights may be had in a wide range of designs and sizes to meet the most exacting needs and tastes. Industrials interested in illuminating and beautifying buildings and grounds can secure literature by writing Mr. O. M. King, President, King Luminaire Company, 37 West Jackson Boulevard, Chicago.



King Luminaire Floodlight

A New Half-Yard Mixer by Smith

The T. L. Smith Company, independent division of the National Equipment Corporation, and mixer builders for the past 30 years, are now



Newly Designed Smith 14-S Non-Tilting Mixer

introducing a new 14-S non-tilting mixer said to be unusually simple in construction and fast in operation.

The drum is of typical Smith design, bigger in diameter and narrow, with 10 deeper full-width discharge buckets and bigger drum openings than former models. It is claimed that these drum improvements permit the use of a wider-throated skip and wider discharge chute, time saving features that assure quicker loading and faster discharge. Complete front end operation is provided, with both charge and discharge sides of the mixer visible. The drum rollers are equipped with oversize Timken bearings in dust tight housings.

Other features include: pressed steel drum heads, short swinging discharge spout and auxiliary stationary spout, band friction hoist clutch and brake, low hot-riveted frame, forged steel rear axle brackets, and wheels that turn under the frame for easy handling. Optional equipment includes a newly designed batch hopper with large swinging gate.

Arco Metal Pipe Enters Water Works Field

Arco metal pipe is a threaded joint corrosive—resisting high quality cast pipe made of alloy iron. It can be cut and threaded at any point within its own length with all standard tools which are used on wrought steel or iron pipe and does not have to be reamed after cutting.

The following statements are made by the manufacturer, the American Radiator Company, New York City:

1. It is true to dimensions, smooth outside and inside.
2. It is free from casting stains
3. It is uniform in wall thickness.
4. All standard floor tables for extra strong wrought steel and iron pipe can be used to figure the capacity of Arco metal pipe.
5. It is resistant to both corrosion and erosion and will not scale inside.

Arco metal pipe is made from a special analysis ni-chrome alloy iron and cast by a process which gives the resultant greater ductility and tensile strength, and also, due to the close grain structure, greater corrosion and erosion resisting qualities than ordinary gray cast iron.

Arco metal nipples and fittings are made for use with the pipe. The pipe is made in sizes from 1½ in. to 6 in. inclusive.

Dietz Announces Roadside Torches

To satisfy a certain amount of demand for roadside torches, which are legal in some states for highway construction work, the R. E. Dietz Company has recently introduced two models. No. 96 is a spherical torch having a weighted bottom which causes it to return to position if tipped or

New Dietz Roadside Torch—No. 96

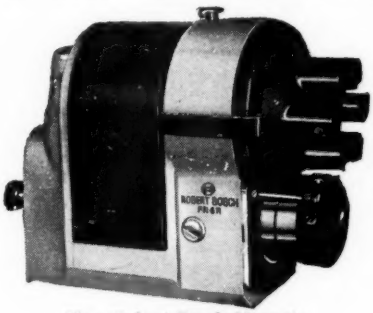
knocked over, while No. 80 is a semi-special torch with a broad, stable, unweighted base and curving sides that operates as a fend against injury. These torches burn either kerosene, light fuel oil or crude distillate. Each is provided with a cast steel burner, heavy carrying loop and an automatic lock that prevents the wick from slipping. They are packaged three in a carton and distributed through the jobbing trade exclusively.

For further information write the R. E. Dietz Co. of New York.

Robert Bosch Announces a New Super-Energy Magneto

A new magneto for 6-cylinder engines has recently been announced by the Robert Bosch Magneto Company, Inc. This instrument, known as type FR6, is designed especially for use on truck, bus, marine, stationary and similar engines where large cylinder capacity or high compression make a powerful magneto desirable. The general appearance of the type FR6 magneto closely resembles that of the Robert Bosch FU type. The chief apparent difference,—besides its slightly larger size,—is the distributor plate which has the high tension outlets at the front instead of at the top. Generous margins of safety are provided to take care of the high voltages developed. The collector ring and certain other electrical parts have been increased in size.

The type FR6 magneto generates an



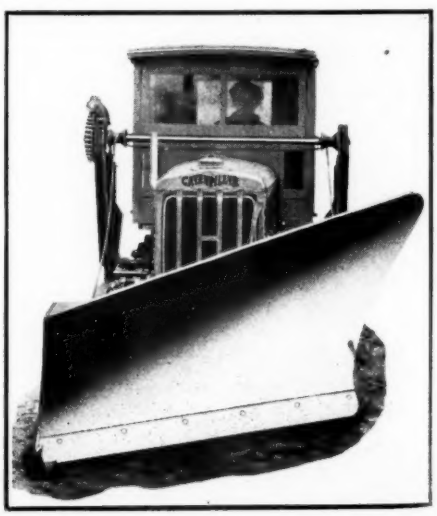
New Robert Bosch Magneto

igniting spark at 30 crankshaft r.p.m. This insures an effective starting spark even at the slowest hand crank speeds. It is recommended for engines operating normally up to 3,000 r.p.m., which covers practically the whole range of commercial engines.

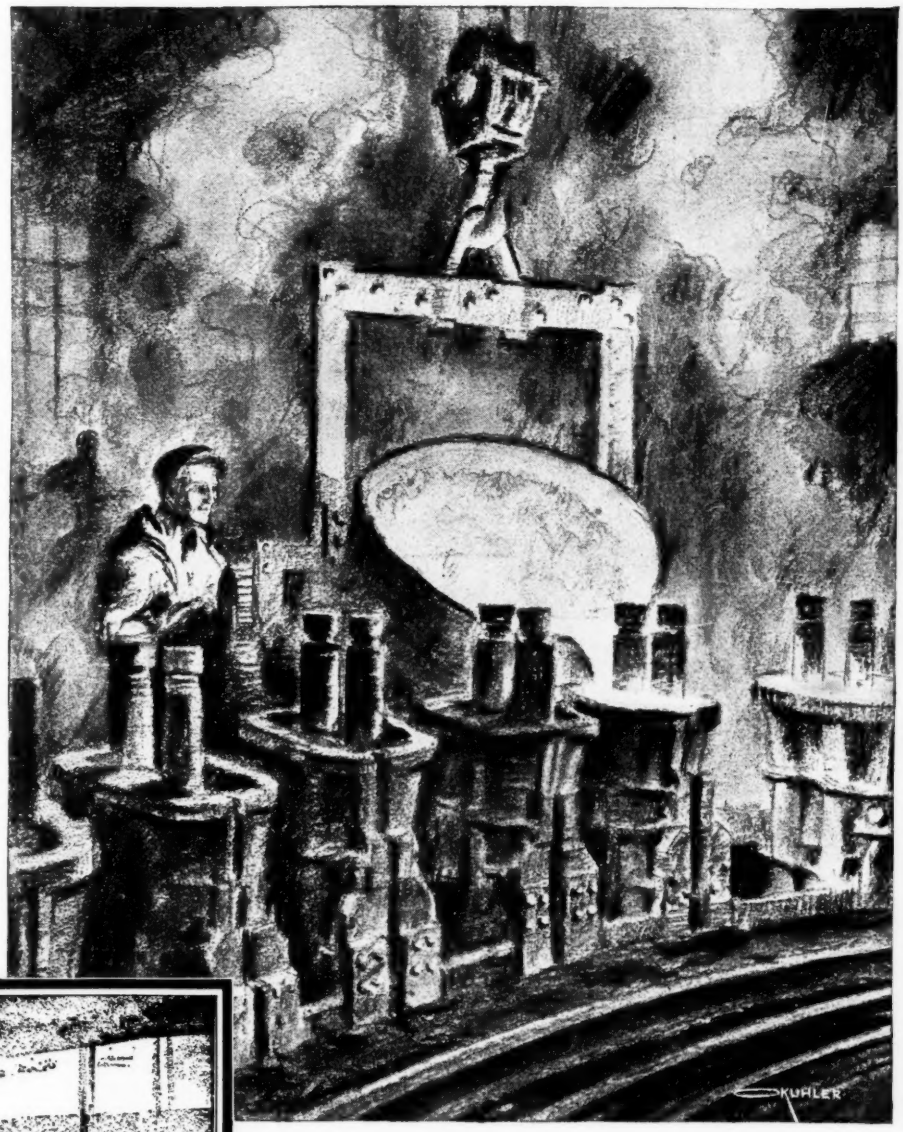
This magneto has all the features characteristic of Robert Bosch Super-Energy magnetos, which have proved highly successful under all sorts of operating conditions. These features include permanently lubricated ball bearings, gap type distributor, dust proof and water proof construction and one piece aluminum alloy frame.

Sidewalk Snowplow Announced

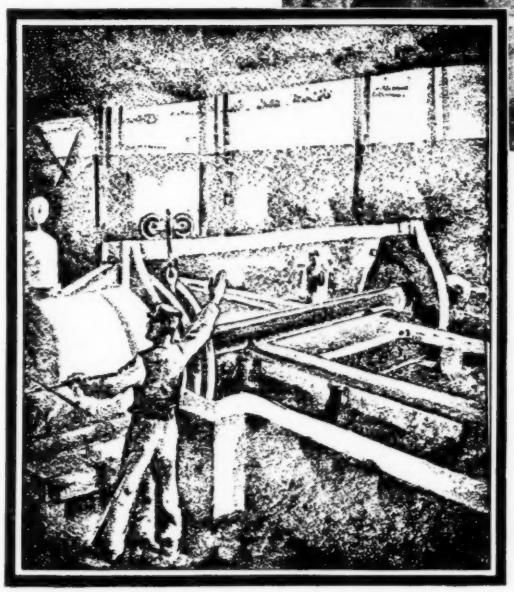
La Plant-Choate Manufacturing Co., Cedar Rapids, Iowa, has just built a side walk snowplow for crawler tractors. It is the answer to the side walk clearing problem in the snow belt where horses are too slow. Write the factory for a catalog or call on some dealer for information.



Sidewalk Snow Plow by La Plant-Choate



Every length of cast iron pipe must pass a severe hydrostatic test as shown below. The pipes are brought into a testing press, sealed at each end and pumped full of water at a pressure as high as 300 lbs. per sq. inch according to the size of pipe.



NOWHERE is scientific control more in evidence than in the foundries of modern cast iron pipe manufacturers. Today, for example, the percentages of carbon and phosphorus necessary to produce greatest strength are known and accurately controlled. Today, the pouring and cooling rates of cast iron pipe are checked with extreme care, and the thickness and diameter of every pipe are tested with precision instruments. It is a noteworthy fact that the manufacture of cast iron pipe today claims a leading place in the ranks of *modern* American industry.

* * *

The Cast Iron Pipe Research Association is a service organization of leading pipe founders, formed to promote the scientific improvement and proper use of Cast Iron Pipe. Pipe bearing the Association "Q-check" mark may be obtained from the following: American Cast Iron Pipe Co., Birmingham, Ala.; James B. Clow & Sons, 219 N. Talman Ave., Chicago, Ill.; Donaldson Iron Company, Emaus, Pa.; Glamorgan Pipe and Foundry Co., Lynchburg, Va.; Lynchburg Foundry Company, Lynchburg, Va.; National Cast Iron Pipe Company, Birmingham, Ala.; United States Cast Iron Pipe & Foundry Company, Burlington, N. J.; Warren Foundry and Pipe Company, 11 Broadway, New York City.

The "Q-check" symbol shown above has been adopted as the trade mark of The Cast Iron Pipe Research Association. Insist on this "Q-check" mark when specifying cast iron pipe for gas, water, sewer, or industrial service.

For complete information write to The Cast Iron Pipe Research Association, Thomas F. Wolfe, Research Engineer, Peoples Gas Building, Chicago.

CAST IRON PIPE

DISTRIBUTOR NEWS

The Distributor's Department in the Gillette Construction Group

Kalbfleisch Corporation Celebrates Century in Chemical Industry

In March the entire organization of the Kalbfleisch Corporation of New York city, together with a few invited guests, gathered at the Fifth Avenue Restaurant to enjoy the company's century dinner and to do honor and tribute to the house of Kalbfleisch.

Mr. Hays H. Clemens, a director of the company, served as toastmaster. Mr. A. B. Savage, vice-president and treasurer outlined the development of the company, James W. Prendergast, general counsel, described operations at the various plants, six in number, stretching from Connecticut to Louisiana, and Mr. Harry L. Derby, president and chairman of the board, visioned the future of the corporation.

Mr. R. A. Asbury, plant manager at Erie, Pa., in behalf of the directors, officers and employees, presented an inscribed silver platter to Mr. Derby.

Kalbfleisch Corporation was founded in 1829 by Martin Kalbfleisch. His son Franklin H. was serving as president at the time of the late war, when he resigned in favor of Mr. Harry L. Derby who has held the office since that time. A message was read from Miss Augusta S. Kalbfleisch paying tribute to the founders of the organization and the present management and expressing the hope that in the future, as in the past, the corporation will stand always for the best.

Novo Engine Company Appoints Many New Distributors

The Novo Engine Company of Lansing, Michigan, manufacturers of hoists, drag lines, engines, pumps, lighting units and similar equipment announce the recent appointment of the following distributors to handle their products: Jersey Contractors Equipment Co., 1020 W. 8th St., Plainfield, N. J.; Fitzgerald & Hudson, 150 Nassau St., New York City; Fred Lemcke, Park & Liberty Ave., Jackson, Mich.; Wylie Bros., Inc., Tulsa, Okla; R. L. McDonald, Inc., Springfield, Mo.; Anderson Tractor & Equipment Co., No. 1 W. Chapel Road, Biltmore, N. C.; Tennessee Tractor Co., 208 Fourth Ave., S., Nashville, Tenn.; Mine & Smelter Equipment Co., 306-12 S. Seventh Ave., Phoenix, Ariz; Lund & Co., 425-8 Dooley Block, Salt Lake City, Utah.

R. T. McClelland, Inc., Oakland, California, who have been Novo distributors for several years are now located in San Francisco and the firm name is Krantz-McClelland, Inc. The San Francisco address is 522 Bryant Street.

American and Concrete "Form-Hold" Merge

A report from the West brings the information that owing to growth of business the Concrete "Form-Hold" Corporation of Culver City has merged with the American "Form-Hold" Corporation, and extensive plans are being made for additional manufacturing facilities.

It is reported that the officers will remain the same, but the sales organization as well as manufacturing facilities will be increased. The American "Form-Hold" Corporation will actively administer the business of the Corporation.

Cutler-Hammer, Inc., Opens Warehouse at Cleveland

Cutler-Hammer, Inc., Milwaukee, Wis., announce the establishment of a warehouse at Cleveland, O. The company has leased 1,600 sq. ft. of floor space for the storage of stock for quick deliveries. A complete line of standard motor control equipment and wiring devices will be available for immediate shipment.

The territory to be served by these new facilities include Cutler-Hammer's entire central district consisting of the states of Ohio and West Virginia, the province of Ontario, western New York and Pennsylvania and sections of Maryland, Indiana, Tennessee and Kentucky. Sales offices for the district are located in Cleveland, Cincinnati, Buffalo and Pittsburgh.

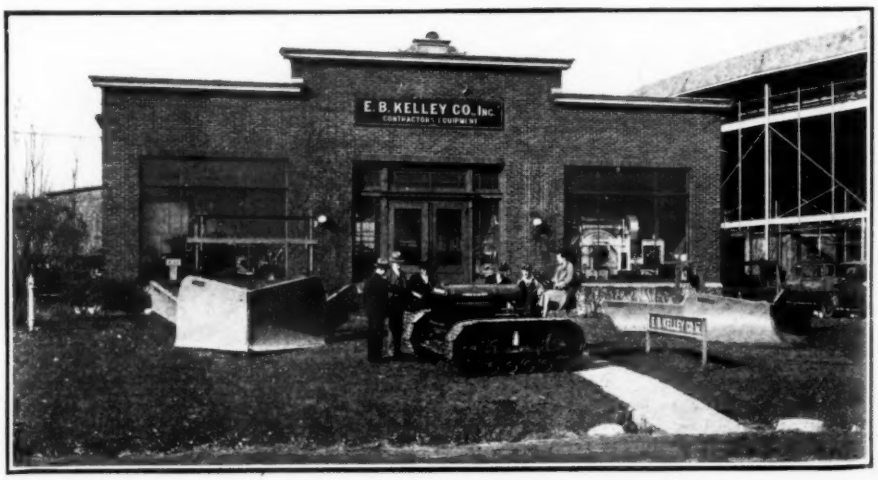
Albany Firm Arranges to Handle Trackson McCormick-Deerings

Among the well-known distributors of general contracting machinery who have recently added tractors and tractor equipment to their lines is the E. B. Kelley Co., Inc., at Albany, N. Y., who is now handling McCormick-Deering Industrial Tractors, Trackson Tractor Equipment, and other related lines.

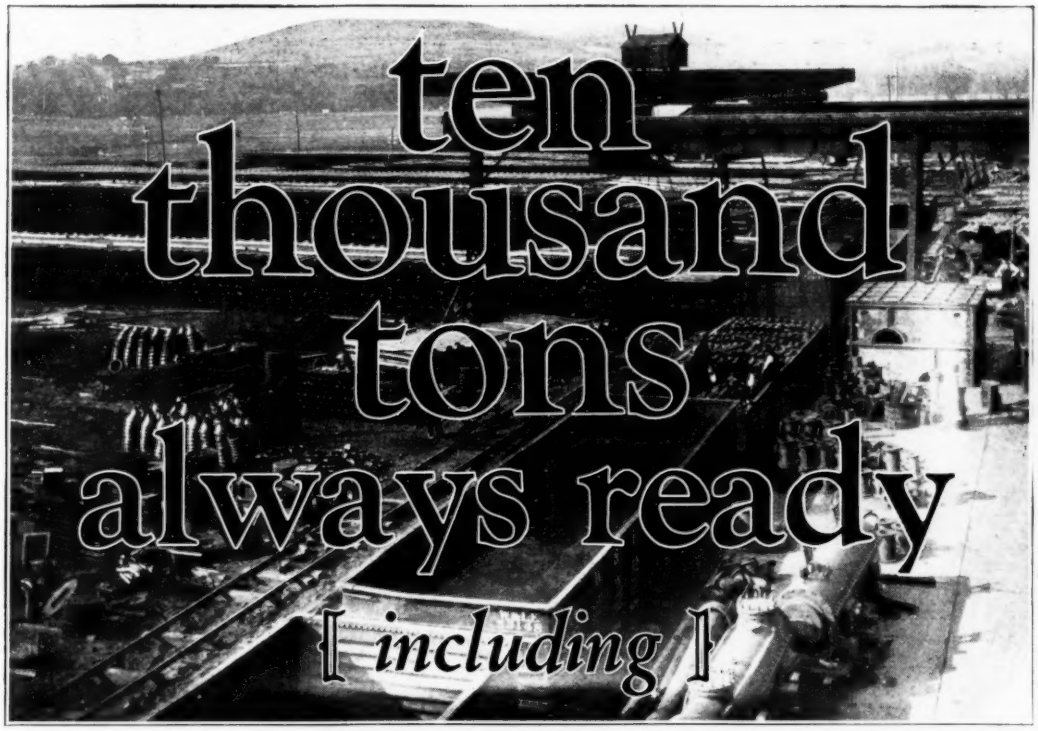
In addition to their establishment at Albany, these distributors have several branches in New York State and Pennsylvania. For many years they have handled concrete machinery of all kinds, derricks, hoists, pumps, and concrete plant equipment. Mr. E. B. Kelley, President of the Company, and other members of the organization are well-known to the contracting trade.

With their long experience in these fields the E. B. Kelley Company were quick to recognize the increasing importance of tractors, and especially crawler tractors, for contracting and industrial purposes. Consequently they arranged for the distribution of Trackson McCormick-Deerings, which they felt would best meet the demands of their trade.

Located as they are in the Capital of New York, these distributors are in the strategic position to get a big share of the State highway business, and they expect to do a big volume on their new lines this year.



Young Lady at Wheel of Trackson McCormick-Deering in Front of Albany Headquarters of E. B. Kelley Co., Inc.



waterworks—sewage disposal—filtration plant—power plant—chemical plant—piping and equipment

The "Q-check" symbol has been adopted as the trade-mark of the Cast Iron Pipe Research Association. Cast Iron Pipe thus marked is produced in accordance with established technical standard specifications by the leading pipe founders of the United States. Clow Cast Iron Pipe is all "Q-Check" pipe.

Insist on the "Q-Check" mark when specifying Cast Iron Pipe for gas, water, sewer, or industrial service.

Because, at Clow, ten thousand tons of pipe and piping equipment are ready now—and always—emergency, and everyday, piping jobs can be filled to better satisfaction.

What's more, Clow makes and stocks equipment carried by no other concern.

Also, Clow Engineers "take off" blue prints, accurately, completely. They estimate the exact cost of the entire piping job.

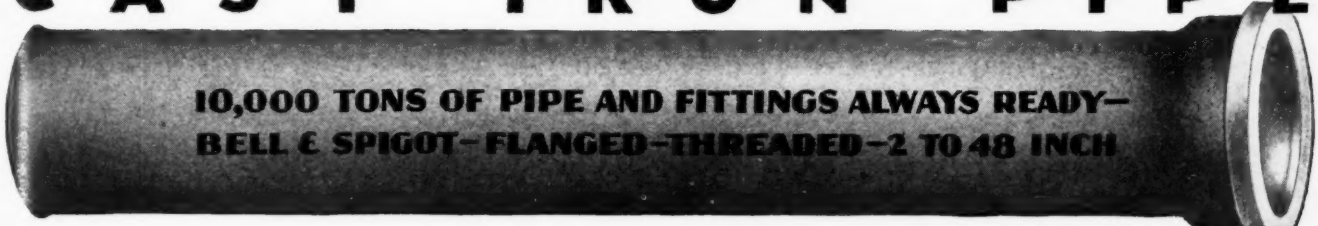
This huge Clow stock—more complete than any other—and this Clow service, can mean more profits for you, and faster, better piping jobs—gas or water.

JAMES B. CLOW & SONS, 201-299 N. Talman Avenue, CHICAGO

Foundries at: Coshocton, Ohio : Newcomerstown, Ohio : Birmingham, Alabama

CLOW-NATIONAL

CAST IRON PIPE



E. P. Goodrich and W. B. Powell Form Association as Consulting Engineers

Formal announcement has been received to the effect that Mr. Ernest P. Goodrich and Mr. William B. Powell will be associated as consultants to municipalities on all traffic matters both in person and through assistants where required.

Mr. Goodrich, who has recently been retained as engineering adviser to the Chinese Nationalist Government, has arranged with his associates so that during his absences from the United States his clients will continue to receive the services of men of the highest reputation and experience. Mr. Goodrich has specialized on traffic matters for many years, having been a member of each Hoover Conference, of the American Engineering Council and the American Engineering Standards Committees, chairman of the New York City Aldermanic Traffic Committee and many others. He is an honorary vice-president of the National Highway Traffic Association, and chairman of the special Traffic Engineers' Committee of the National Safety Council. His traffic surveys cover nearly fifty municipalities.

Mr. Powell is consulting traffic engineer of Buffalo, N. Y., chairman of the American Engineering Council and of the American Engineering Standards Committee on Signs, Signals and Markings. He and Mr. Goodrich will undertake street traffic and related studies for cities and other governmental units, will make recommendations as to traffic signal installations, and will supervise their purchase and installation. Their New York offices are at 175 Fifth Avenue.

Eldon S. Clark Heads Consulting Service Department

The Michigan Valve and Foundry Company has recently inaugurated a new service, whereby technical advice is made available to those in charge of projects involving water supply and distribution, drainage and sewage works, particularly where piping is an important factor.

The administration of this service has been turned over to Mr. Eldon S. Clark, a well known engineer who has been associated with many important projects throughout the East.

Mr. Clark's experience since graduating from the Massachusetts Institute of Technology has included the construction of hydraulic and railroad projects for Barrows & Breed; designer and assistant engineer on power plant work and industrial building construction for Stone & Webster, and assistant engineer with Metcalf & Eddy where he was engaged in water supply and sewage disposal work, in the designing and construction of systems.

Among some of the projects with which Mr. Clark has been connected are the distribution system at Waterville, Me.; water supply work at Plattsburgh, N. Y., including a large earth dam and connecting works; extensive housing development at Hopedale, Mass., which included water supply, drainage and sewage disposal works; design and supervision of construction for additions to distribution

Eldon S. Clark

systems at both Quincy, Mass. and Revere, Mass.; in a consulting capacity on the construction work of the large earth dam now being built at Johnstown, Pa., and the investigation of the adequacy of the water supply and the requirements for distribution to districts not formerly supplied at Concord, N. H.

Mr. Clark is affiliated with both the American Society of Civil Engineers and the Boston Society of Civil Engineers. It is his intention to co-operate closely with both municipal and industrial engineers in supplying needed information in both design and construction of work under their jurisdiction. Requests for this service may be made directly to Mr. Clark in care of the Michigan Valve & Foundry Co., 3631 Parkinson Ave., Detroit.

Penn Machinery Moves to Larger Quarters

In order to care for their enormously increased business the H. O. Penn Machinery Company, 18 E. 41st St., New York City, are moving their general offices and warehouse to Bronx, according to statement of Mr. T. A. McDonald for the company.

The warehouse, now located at 134th St. and Third Ave., is being moved to Port Morris Terminal at 140th St. and East River, Bronx, New York, where extensive property has been leased. It is stated that by May 1 the warehouse and general offices will be fully established at the new location, thus placing this company in the front rank in the matter of office and warehouse facilities.

H. O. Penn Machinery Company is well known in the field of construction and industrial equipment distribution, handling Byers cranes and shovels, Chain Belt pavers and mixers, Rex pumps and saw-rigs, Butler bins and weighing devices, O. K. compressors and hoists, etc. In addition to the equipment named, they have recently secured the exclusive agency in their territory for the International Harvester tractors.

Stearns-Roger to Represent Chicago Pneumatic Tool in Intermountain Country

Announcement has been received to the effect that the Stearns-Roger Manufacturing Co. will act as agents for the Chicago Pneumatic Tool Company of New York, this to be in addition to its engineering, manufacturing and contracting business.

Messrs. Barrett, Townsend and Bartlett, who have been connected with the compressor and drill departments for so many years, will explain to all operators the merits of the various machines offered.

A complete stock of compressors, both stationary and portable, rock drills, pneumatic tools and repair parts will be carried in the Denver warehouse, 1720 California St., Denver, Colo.

Contractors Equipment Co. to Handle Manitowoc Products in Michigan

Announcement has just been made by Manitowoc Engineering Works, Manitowoc, Wis., that Contractors Equipment Company, Detroit, Mich., has taken on the sale and servicing of Moore speedcranes, shovels, draglines and trenchoes, also the Buffalo-Manitowoc clamshell bucket, in the state of Michigan.

W. T. Morgan Joins Chicago Pump

W. T. Morgan formerly with Gould's Pumps, Inc., has joined the Chicago Pump Company. He will be located at the New York Office, where he will serve as manager of Engineering Service. Architects, engineers or contractors in need of pump information will be referred to Mr. Morgan.

Sullivan Machinery Company, 122 S. Michigan Ave., Chicago, will be located at 819 Wrigley Building, 400 N. Michigan Ave., Chicago, after May 1.

SERVICE PIPE of COPPER or BRASS

protects health and cuts down repairs

COPPER AND BRASS *cannot* rust. By using them for service pipe, you protect the city water department from complaints arising from poor flow or discolored water. You safeguard the health of citizens. And you minimize the possibility of expensive repairs with consequent digging and paving work.

By urging the use of Brass for all *interior* water piping in the homes of your city, you make sure that the pure water supplied by the city will reach consumers in its original, clean, healthful state.

Copper or Brass pipe may cost a little more than the rustable or so-called *rust resisting* kind. But the many years of trouble-free service that they give make them a very worth while economy in the long run. Because they *cannot* rust, they do not leak or clog.

This association will be glad to supply full information about Brass or Copper pipe or cooperate with you to the fullest extent in any efforts you care to make toward furthering the use of these rust-proof pipes in your municipality.

COPPER & BRASS
RESEARCH ASSOCIATION
25 Broadway, New York

Midwestern Office:	*Canadian Office:*	*Pacific Coast Office:*
Landreth Building	67 Yonge Street	Architects Building
St. Louis, Mo.	Toronto, Ont.	Los Angeles, Calif.

COPPER, BRASS, BRONZE — *The World's Most Useful Metals*

Theodore F. Merseles

The death of Theodore Frelinghuysen Merseles at Del Monte, Calif., on March 6th, removed from the business world one of its most successful organizers and managers, and one of the world's outstanding masters of practical merchandising, selling and administration.

Mr. Merseles was born August 17, 1863, in Jersey City, a descendant of Early Dutch settlers. He finished school at eighteen and began his long career of business achievement with the Pennsylvania Railroad and Trunk Line Association as clerk and stenographer.

His instinctive merchandising genius first found an outlet through the Western Wheel Works in the middle nineties when the bicycle fad was at its height.

Theodore F. Merseles

Competition in the field was intense, and as vice-president and general manager of this small company Mr. Merseles negotiated a combination with Col. A. A. Pope of Hartford and A. G. Spalding of Chicago, resulting in the American Bicycle Company, known as the "bicycle trust," with himself as vice-president.

In 1903, at the age of forty, Mr. Merseles decided to seek other fields of endeavor, and seeing opportunity in the mail order business, joined the National Cloak and Suit Company, which was then doing an annual business of about one million dollars. For eighteen years he stayed with this company, becoming vice-president and general manager. When he resigned in 1920, to become president of Montgomery Ward and Company, the business of the National Cloak and Suit Company totaled fifty million a year.

Selected by J. P. Morgan and Company to guide Montgomery Ward out of its post-war $9,000,000 deficit of 1920, Mr. Merseles with his new policies, new merchandising plans and able leadership brought this pioneer mail order house back to the top in its field until in 1926 its sales totaled over 185 million dollars and a profit of nearly nine million.

In 1927, J. P. Morgan and Company again called upon him, this time to become president of the Johns-Manville Corporation, which position he held at the time of his death. By application of his exceptional organization and merchandising ability he was again successful in increasing sales and profits, and in establishing and putting into effect further aggressive policies. The Board of Directors and Executive Officers of Johns-Manville have expressed the intention to continue and follow out all the progressive policies as planned and established by their president at the time of his death.

Mr. Merseles is survived by his widow, Mrs. Elizabeth Rich Merseles, and two sons, Herbert E. and Theodore I. Merseles. His home was in Bronxville, New York.

Chicago Pump Company Conduct School for Representatives

In order that the representatives of the Chicago Pump Company may give the architects, engineers, contractors and owners correct pump information where it is desired, the manufacturer has instituted a "Pump School," for instruction in the manufacture and merchandising of electrical centrifugal pumps. All new members of the Chicago Pump Company organization will be asked to go through the school.

The course is designed to educate the new men concerning the details of production, application of pumps and information necessary to properly figure a pump job. The production program calls for work in the machine shops, assembly floor, switch department, testing and service departments. The student also spends considerable time with experts to familiarize himself with the various conditions met with on pump jobs.

The three most recent graduates of the "Pump School" are Mr. Sidney Steiner of the New York office of the manufacturer; Mr. W. K. (Happy) Hornbuckle, representative at Memphis, Tenn., and Mr. Raymond Trethaway, who has taken the architect's engineering service, in order to cooperate with architects and engineers in Detroit, where he will assist "Tandy" Jackson.

"Business as Usual"

Mr. A. B. Chance, president of the Chance Company, Centralia, Missouri, believes in, "business as usual," despite such accidental interruption as fires.

When an explosion wrecked and set fire to the Chance Company warehouse recently Mr. Chance immediately telephoned the St. Louis Branch Office of the Truscon Steel Company for an engineer to assist in planning the replacement of the building.

Within four hours the engineer had traveled the 125 miles to Centralia and was estimating materials from hastily sketched plans. All night, while the fire burned itself out, the rebuilding program was revised and developed, and at 4:30 A. M. the contract for a new warehouse was signed while the ruins of the old one still smoked.

Work is being pushed to give the Chance Company a new Warehouse in record time. They make automobile and electrical specialties.

Cleveland Tractor Reports $100,000 in Cash Business from Two Orders

Mr. C. D. Fleming, vice-president of the Cleveland Tractor Company, reports the receipt of two large orders recently to add to this year's splendid record of sales. The orders were received from the State Highway Department of Arkansas and the Provincial Government of British Columbia, Canada, for large fleets of Cletracs.

These two orders alone, Mr. Fleming states, amount to more than $100,000 in cash business. Both orders represent repeat business for the company and bring the total number of Cletracs used by the Provincial Government of British Columbia up to eighty-two machines. The tractors are wanted for road construction and maintenance work.

The company reports notable progress in sales of large fleets of tractors to state highway departments throughout the country, individual purchases in some instances amounting to more than a hundred tractors.

Ferris Company to Handle United Tractor in Texas

The Ferris Tractor Company has been formed in Dallas, Texas, to distribute the full line of United Tractor & Equipment Corporation tractors and equipment in north and west Texas.

J. W. Ferris, president of the new company, has been connected with the tractor equipment business as president of the F-D Equipment Company, Fordson implement and equipment distributors, since its organization four years ago. F. A. Ferris, well known to the trade, will serve as vice-president, and H. L. Burleson as manager. Mr. Burleson has had 10 years' experience in the tractor and implement business in Texas, the past four with the F-D Equipment Company.

Change of Address

The New York Offices of Page Steel & Wire Company were recently moved from Grand Central Terminal Building to new quarters in the New York Central Building at 230 Park Avenue.